



An annotated bibliography of boreal mixedwood literature of the prairie provinces

W.L. Strong and I.G.W. Corns

Northern Forestry Centre
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**AN ANNOTATED BIBLIOGRAPHY OF
BOREAL MIXEDWOOD LITERATURE
OF THE PRAIRIE PROVINCES**

W.L Strong¹ and I.G.W. Corns

INFORMATION REPORT NOR-X-363

Canadian Forest Service
Northern Forestry Centre
1999

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ABSTRACT

This bibliography contains 787 references dealing with boreal mixedwood forests and their management. Citations primarily cover the Canadian prairie provinces, but work from other locations is also included. The primary objective was to compile ecological- and biophysical-resource literature related to deciduous and mixedwood boreal forests. With each citation, a brief summary, location of the study area, and key words are provided to assist users in evaluating each reference. Major subject areas are ecological considerations, natural-resource assessment, natural-resource development effects, silviculture, sustainable benefits, tree species, and wildlife resources. The entries are arranged in alphabetical order and indexes by subject and geographical location are provided.

RÉSUMÉ

Cette bibliographie contient 787 références sur les forêts boréales mixtes et leur mode d'exploitation. Les citations couvrent principalement les provinces canadiennes des Prairies, mais certains ouvrages concernant d'autres endroits ont été ajoutés. L'objectif premier était de compiler toute la littérature écologique et biophysique liée aux forêts décidues et boréales mixtes. Chaque citation est accompagnée d'un bref résumé, de l'indication de l'emplacement de la zone d'étude, et de termes clés afin que les usagers puissent évaluer chaque référence. Les principaux domaines traités sont les considérations écologiques, l'évaluation des ressources naturelles, les effets du développement des ressources naturelles, la sylviculture, les bénéfices durables, les espèces d'arbres et les ressources en espèces sauvages. Les entrées sont en ordre alphabétique et on retrouve des index par sujet et par emplacement géographique.

PREFACE

Forests of aspen (*Populus tremuloides* Michx.) and balsam poplar (*Populus balsamifera* L.) dominate the northern half of Alberta, the southwest portion of the Northwest Territories, northeastern British Columbia, central Saskatchewan, and part of southwestern Manitoba. These areas include both the Mixedwood (B.18a and B.18b) and Lower Foothills Forest sections as described by Rowe (1972). The primary difference between these forest sections in terms of their tree species composition is the occurrence of lodgepole pine (*Pinus contorta* Dougl.) in the latter area. Another common component of these forests is white spruce (*Picea glauca* [Moench] Voss), which increases in abundance as stands age. Historically, commercial interest in these forests has been the harvesting of the coniferous components; however, during the past 10–15 years, interest has increased dramatically in the deciduous component (e.g., for pulp mills, wafer-board plants), but ecological research and planning to ensure sustainable development has lagged relative to the rate of resource development.

This bibliography brings together ecological and biophysical-resource literature related to deciduous and mixedwood boreal forest ecology within Alberta, Saskatchewan, and Manitoba. Related biophysical-resource literature includes studies and documents such as soil surveys, surficial geology studies, ecological land classifications, and large-area land-use plans that could potentially be useful to boreal forest ecologists and to organizations interested in promoting the sustained management of boreal mixedwood ecosystems.

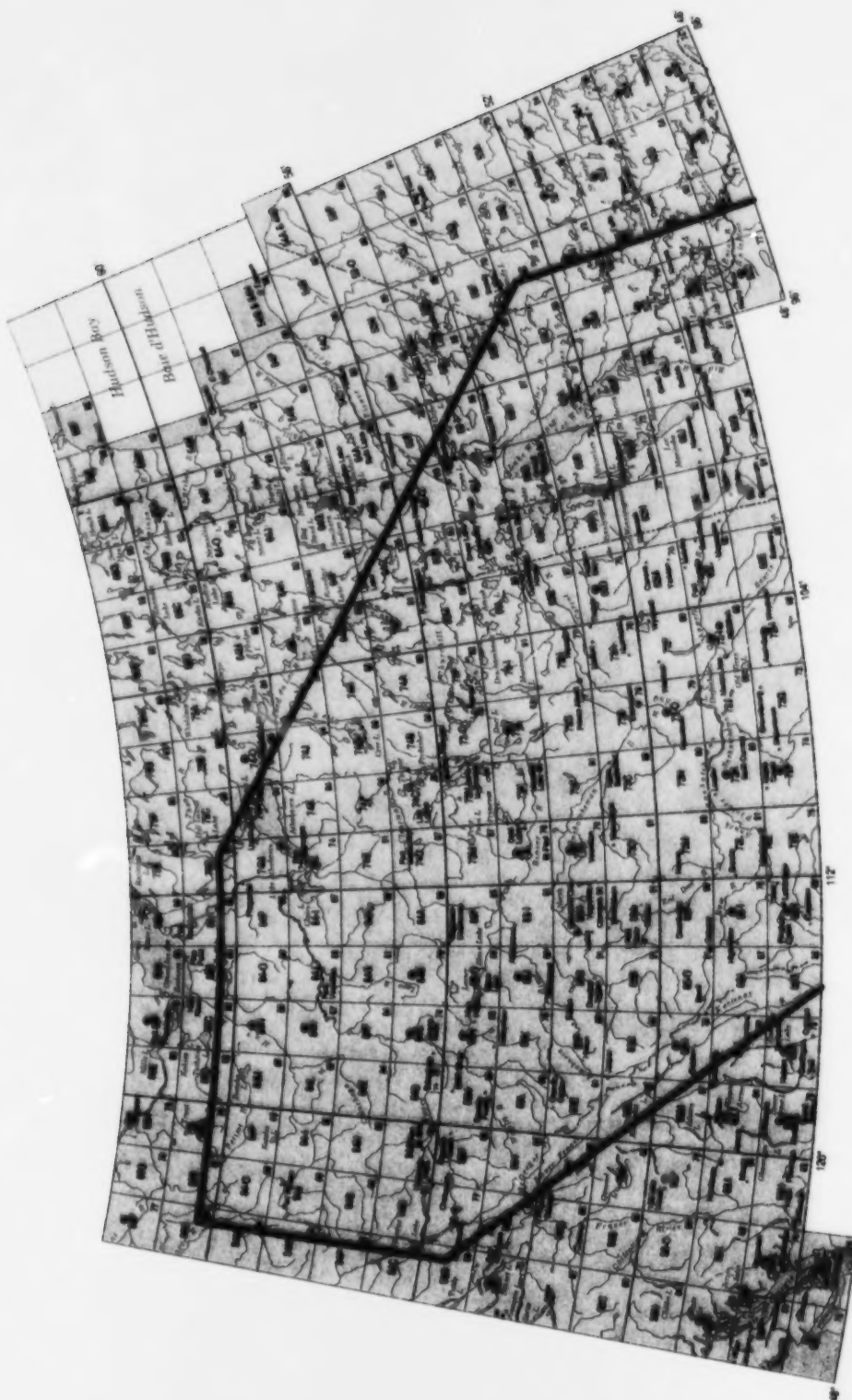
Materials for this bibliography were obtained from searching card catalogues and microfiche files, a review of information in computerized data bases, and a review of citation lists included in research papers and technical reports. Attention is focused on studies conducted after the 1950s,

although older, still-relevant citations are also included if still readily accessible.

The following libraries are the principal sources where publications were reviewed:

- Alberta Environmental Protection Library, Edmonton
- Bruce Peel Special Collections Library, University of Alberta, Edmonton
- Cameron Library, University of Alberta, Edmonton
- Canadian Circumpolar Library, University of Alberta, Edmonton
- Canadian Wildlife Service Library, Edmonton
- Northern Forestry Centre Library, Edmonton
- Saskatchewan Renewable Resources and Parks Library, Prince Albert
- University of Calgary Library, Calgary
- University of Saskatchewan Library, Saskatoon

In some cases, potentially relevant citations are included even though they were not available to the authors. Each citation includes a summary of the purpose of each study and the type of information included. Also included with each citation is a general geographical location where the study was conducted. These locations are based on National Topographic Series map sheet designations (e.g., 83 L) or by geographical regions (e.g., Alberta). Subject and geographical location indexes appear at the end of the bibliography to assist users with identifying potentially relevant studies.



ACKNOWLEDGMENTS

This project was funded by the Canadian Forest Service under the Green Plan Forestry Practices Program (Phase I). M. Olson assisted with the library search, review, and compilation of the bibliography during its initial development in 1992, and B. Stelfox (formerly with Alberta Environmental Research Centre) provided a bibliography that he had compiled. Reviews of the manuscript

and citations were provided by S. Navratil (formerly with the Canadian Forest Service, Alberta), V. Lieffers (University of Alberta), K. McClain (McClain Forest Company Ltd.), and J. Scarratt (Canadian Forest Service, Ontario). Editorial assistance was provided by B. Laishley, D. Leroy, and E. Schiewe (Canadian Forest Service, Alberta); their assistance is gratefully acknowledged.

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Note

The exclusion of certain manufactured products does not necessarily imply disapproval nor does the mention of other products necessarily imply endorsement by Natural Resources Canada.

BIBLIOGRAPHIC LISTING

Abouguendia, Z.; Baschak, L.A.; Godwin, R.C. 1986. Effects of simulated acidic precipitation on Saskatchewan crop and forest species: results of the 1985/86 experiments. Sask. Res. Council, Saskatoon, Saskatchewan. Tech. Rep. 191.

The effects of simulated acid rain are assessed on several agricultural crops and forest tree species. The results suggest that pH values higher than 3.6 had minimal effects on the studied species. Effects were only detected at levels of approximately 2.6. In some cases, aboveground growth was enhanced by low pH. At low pH, visible damage was evident in white spruce and aspen, but neither growth nor physiological factors were affected. Increased acidity could increase the availability of nutrients. (Location: Saskatchewan)

Key words: Pollution effects, soil and site conditions, vegetation assessment, white spruce, aspen

Abouguendia, Z.M.; Godwin, R.C. 1980. The effects of acidic precipitation on plants with special reference to N. Saskatchewan and N.E. Alberta. Sask. Res. Council, Saskatoon, Saskatchewan. Publ. C-805-28-E-80.

The authors evaluate the effects of acidic precipitation on boreal forest vegetation, based on a review of available literature. They tentatively conclude that bogs and aquatic macrophyte ecosystems would be the most sensitive. Recommendations are made for further study. (Location: Alberta)

Key words: Pollution effects, vegetation assessment

Achuff, P.L. 1992. Natural regions and subregions of Alberta: a revised classification for protected areas management. Alta. Tourism Parks Rec., Alta. Parks Serv., Edmonton, Alberta and Alta. For. Lands Wildl., Edmonton, Alberta. Rep. 2.

This paper describes a region and subregion 1:1 000 000-scale classification of Alberta based on landscape patterns and related

natural-history themes. The system includes six regions and 19 subregions. A variety of natural history themes are recognized for each subregion. (Location: Alberta)

Key words: Ecological land classification, unique resources, economics—nonfiber

Addison, P.A. 1980. Ecological bench-marking and biomonitoring for detection of airborne pollutant effects on vegetation and soils. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 111.

Forest communities sampled in 1976–77 were resampled in 1979 to determine if air pollution from tar-sands processing plants had affected the understory vegetation. Soils were also collected and retested for sulfur, aluminum, iron, vanadium, and nickel. The author found little difference in the vegetation between the two different sampling periods. (Location: 74 D, E)

Key words: Pollution effects, vegetation assessment, soil and site conditions

Addison, P.A. 1982. Biomonitoring in the Athabasca Oil Sands area of Alberta: progress and pitfalls. Pages 332–367 in Symp./Workshop Proc. Acid Form. Emiss. Alta. Ecol. Eff., March 9–12, 1982, Edmonton, Alberta. Alta. Environ., Res. Manage. Div., Edmonton, Alberta.

A background review and preliminary results of biological and atmospheric monitoring program in the Alberta Oil Sands Environmental Research area are presented. Much of the vegetation work focuses on assessment of conifers and lichens. (Location: 74 D, E)

Key words: Pollution effects, vegetation assessment, soil and site conditions

Addison, P.A. 1984. Biomonitoring of air pollution impacts in the Athabasca Oil Sands forests. Pages 4–5 in J.K. Samoil and G.B. Turtle, eds. Toxic substances and the forest environment. Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. For. Rep. 30.

This paper describes and reviews the use of plants as tools for monitoring air-transported pollutants in the Alberta Oil Sands Environmental Research Program area. The author recognizes the labor-intensive nature of this approach as a disadvantage. (Location: 74 D, E)

Key words: Pollution effects, vegetation assessment

Addison, P.A.; Kennedy K.A.; Maynard, D.G. 1984. Effects of sour gas processing on a forest ecosystem in west-central Alberta. Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-265.

This paper investigates the impact of sour gas from two processing plants on forest plants and soils. The sulfur content in soils was found to have increased within the impingement zone. The greatest effects on vegetation were found nearest the source in the form of reduced herb cover and bryophyte diversity. Bryophytes were found to be the most sensitive to sulfur deposition. Trees did not show either a growth or reproduction response. (Location: 83 B)

Key words: Pollution effects, vegetation assessment, soil and site conditions, lodgepole pine

Addison, P.A.; L'Hirondelle, S.J.; Maynard, D.G.; Malhotra, S.S.; Khan, A.A. 1986. Effects of oil sands processing emissions on the boreal forest. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-284.

The results of a 10-year study on the effects of emissions from oil-sands processing plants in the Fort McKay area on boreal vegetation are presented. The effects were primarily limited to within 10 km of the source. Lichens and mosses were found to be the most sensitive to sulfur deposition, while vascular plants showed minimal response. Most of this research was oriented toward jack pine stands. (Location: 74 D, E)

Key words: Pollution effects, vegetation assessment, soil and site conditions, jack pine

Addison, P.A.; Malhotra, S.S.; Khan, A.A. 1984. Effect of sulfur dioxide on woody boreal forest species grown on native soils and tailings. J. Environ. Qual. 13:(3)333-336.

This study experimentally found that net assimilation rates decreased more rapidly in deciduous than coniferous or evergreen plants when exposed to sulfur dioxide. Response was influenced by both the timing and duration of exposure. (Location: Not applicable; laboratory study)

Key words: Pollution effects, vegetation assessment, aspen, white spruce, black spruce, jack pine, white birch

Addison, P.A.; Puckett, K.J. 1980. Deposition of atmospheric pollutants as measured by lichen element content in the Athabasca oil sands area. Can. J. Bot. 58:2323-2334.

The metal content of lichens is related to their proximity to gaseous and particulate emissions from oil-sands processing plants. This study was an early attempt to use lichens in biomonitoring in the Alberta Oil Sands Environmental Research Program area. Contaminant concentrations were correlated with distance from source. (Location: 74 D, E)

Key words: Pollution effects, vegetation assessment, black spruce

Airphoto Analysis Associates. 1979. Integrated resources survey: Wood Buffalo National Park, Alberta and Northwest Territories. Airphoto Anal. Assoc., Toronto, Ontario.

This study is a broad overview of the biophysical resources of Wood Buffalo National Park with a 1:100 000-scale land classification. Most of the report focuses on the physical resources of the area. Vegetation is classified on the basis of physiognomy, although some floristics lists are presented. (Location: 84 I, P; 74 L, M)

Key words: Ecological land classification, physical land classification and geology, vegetation classification, soil survey, soil and site conditions

Alberta Energy and Natural Resources. 1984a. A policy for resource management of the eastern slopes. Alta. Energy Nat. Resour., Edmonton, Alberta. Rep. T/38. Rev. ed.

This report presents a revision of the Eastern Slope zonation and management policy. Eight general land-use zones are recognized and

mapped at a scale of 1:250 000. Compatible, permitted, and not permitted uses are identified for each zone. (Location: Alberta)

Key words: Resource planning, forest policy

Alberta Energy and Natural Resources. 1984b. Status of the fish and wildlife resource in Alberta. *Alta. Energy Nat. Resour., Fish Wildl. Div., Edmonton, Alberta. Rep. 1/87.*

An overview is given of Alberta's fish and wildlife resources, including economic value, management concerns, population size, and distributional information. Diagrams identify general range and population sizes of individual species between 1960 and 1980. (Location: Alberta)

Key words: Wildlife distribution and diversity, economics-nonfiber, ungulates, birds, small mammals, furbearers

Alberta Energy and Natural Resources. 1985a. Big Bend sub-regional integrated resource plan. *Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/1-15.*

The paper discusses an area (4500 km²) located between Lesser Slave and Calling lakes that was subdivided into several resource-management areas for the purpose of developing a land-use plan. Resource-management objectives and guidelines were established within each area. (Location: 83 I, J, O, P)

Key words: Resource planning

Alberta Energy and Natural Resources. 1985b. Frost Hills local integrated resource plan. *Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/1-13.*

A land-use plan prepared for an area (1093 km²) located along the south side of Lesser Slave Lake is discussed. The planning area was zoned according to broad categories. Most of the land in the planning area was allocated to either multiple use or agricultural development. (Location: 83 O)

Key words: Resource planning

Alberta Energy and Natural Resources. 1985c. Jean D'Or Prairie sub-regional integrated resource plan. *Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/1-16.*

This paper reports on a land-use plan prepared for an area (1455 km²) located near Fort Vermilion. The planning area was zoned according to broad categories. Approximately equal amounts of land in the planning area were allocated to multiple use and agriculture. (Location: 84 J)

Key words: Resource planning

Alberta Energy and Natural Resources. 1985d. Lakeland sub-regional integrated resource plan. *Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/1-17.*

This paper reports on a land-use plan prepared for an area (3400 km²) located southeast of Lac La Biche. The planning area was zoned according to broad categories. In the plan, several areas, primarily around lakes, were zoned to emphasize recreational use. (Location: 73 L)

Key words: Resource planning

Alberta Environmental Centre. 1981. The impact of industrial activity on the population ecology of grizzly and black bears in the boreal forest of northwestern Alberta. *Alta. Environ. Cent., Vegreville, Alberta.*

Not available for review. (Location: Alberta)

Key words: Furbearers, environmental-impact effects

Alberta Environmental Protection. 1993. Athabasca River sandhills local integrated resource plan. *Alta. Environ. Prot., Edmonton, Alberta. Publ. 1/464.*

A multiple-land-use plan was prepared for a 416-km² area located along the Athabasca River near Fort Assiniboine. The area was zoned into five broad categories, and management objectives and guidelines were established for various resources. (Location: 83 J)

Key words: Resource planning, economic—fiber, economic—nonfiber, recreation, forest policy

Alberta Environmental Protection. 1996a. Cold Lake subregional integrated resource plan. Alta. Environ. Prot., Edmonton, Alberta. Publ. I/429.

A land-use plan was developed for a 8400-km² area located east of Cold Lake. Modifications were made to the Green/White Zone boundary, and numerous resource-management areas were established, primarily around the larger lakes. (Location: 73 L)

Key words: Resource planning, economic—fiber, economic—nonfiber, recreation, forest policy

Alberta Environmental Protection. 1996b. Fort McMurray–Athabasca Oil Sands subregional integrated resource plan. Alta. Environ. Prot., Edmonton, Alberta. Publ. I/358.

A land-use plan was developed for a 385-km² area near Fort McMurray. The area was subdivided into resource-management areas, and objectives and guidelines were developed for each area. A map of moose habitat quality is included in the report. (Location: 74 D, E)

Key words: Resource planning, ungulates, wildlife habitat assessment

Alberta Forestry, Lands and Wildlife. 1986a. Brazeau–Pembina sub-regional integrated resource plan. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/1-9.

A land-use plan was prepared for a 2950-km² area located west of Drayton Valley. The planning area was zoned according to broad categories. The majority of the area was allocated to a multiple-use zone, although several critical wildlife areas were also recognized. (Location: 83 B, C, F, G)

Key words: Resource planning

Alberta Forestry, Lands and Wildlife. 1986b. Nordegg–Red Deer River sub-regional integrated resource plan. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Publ. T/1-10.

A land-use plan was prepared for a 3820-km² area southeast of Abraham Lake. The planning area was zoned according to broad categories. Most of the area was allocated to a multiple-use

zone. Several critical wildlife areas were also recognized. (Location: 83 B, C)

Key words: Resource planning

Alberta Forestry, Lands and Wildlife. 1986c. Rocky–North Saskatchewan sub-regional integrated resource plan. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/1-8.

A land-use plan was prepared for a 7000-km² area west of Rocky Mountain House. The planning area was zoned according to broad categories. The majority of land was allocated to a multiple-use zone. (Location: 83 B)

Key words: Resource planning

Alberta Forestry, Lands and Wildlife. 1987a. Bear River–Wapiti local integrated resource plan. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/145.

A land-use plan was prepared for a small area (about 60 km²) located southeast of Grande Prairie. The plan primarily focused on the use and protection of an environmentally sensitive area with an emphasis on recreation and tourism. (Location: 83 M)

Key words: Resource planning, unique resources

Alberta Forestry, Lands and Wildlife. 1987b. Keg River sub-regional integrated resource management plan. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Publ. T/159.

A land-use plan was prepared for a 1696-km² area in northwestern Alberta. The planning area was zoned according to broad categories. The majority of land was allocated to the green zone (permanent forest land), but the agricultural zone represented a significant amount of land. (Location: 84 F)

Key words: Resource planning

Alberta Forestry, Lands and Wildlife. 1987c. Smoky–Peace Point local integrated resource plan. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/142.

A land-use plan was prepared for a 821-km² area south of the Peace River townsites along the Peace River. The crown portion of the planning area was subdivided and management objectives were established for various uses. (Location: 84 C; 83 N)

Key words: Resource planning

Alberta Forestry, Lands and Wildlife. 1987d. Sturgeon Lake-Puskwaskau East sub-regional integrated resource plan. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/1-14.

A land-use plan was prepared for a 5830-km² area in the vicinity of Valleyview. The planning area was zoned according to broad categories and resource-management objectives were established for each area. (Location: 83 N)

Key words: Resource planning

Alberta Forestry, Lands and Wildlife. 1988. Integrated resource inventory of Fox Creek-Knight study area. Alta. For. Lands Wildl., Land. Inf. Serv. Div., Edmonton, Alberta. Publ. T/185.

An ecological land classification (1:100 000) was carried out in the Fox Creek-Knight area. The study's mapping summarizes the climatic zones, regional physiography, vegetation, and physical attributes of the area, but little supporting biophysical information is provided. (Location: 83 K)

Key words: Ecological land classification, land evaluation

Alberta Forestry, Lands and Wildlife. 1990. Coal Branch sub-regional integrated resource plan. Alta. For. Lands Wildl., Edmonton, Alberta. Publ. I/294.

A land-use plan was developed for a 8400-km² area located southwest of Edson. The area was zoned according to broad categories of land use, with most of the area allocated to multiple use. A prime protection zone was established for the mountainous portions of the area. (Location: 83 C, F)

Key words: Resource planning

Alberta Forestry, Lands and Wildlife. 1991a. Grande Prairie County West local integrated resource

plan. Alta. For. Lands Wildl., Edmonton, Alberta. Publ. I/368.

A land-use plan was prepared for a 930-km² area west of Grande Prairie along the British Columbia border. The planning area was zoned according to broad categories. About half of the area was allocated to forest-based land management. (Location: 83 M, L)

Key words: Resource planning

Alberta Forestry, Lands and Wildlife. 1991b. Integrated resource inventory and evaluation of Berland study area. Alta. For. Lands Wildl., Resour. Inf. Branch, Edmonton, Alberta. Publ. T/231.

An ecological land classification was prepared (1:100 000) and ratings were developed for winter-habitat suitability for moose, elk, and caribou; forest capability; and improved grazing. Only the eastern portion of the study area consisted of Lower Boreal-Cordilleran and Mixedwood forests. (Location: 83 K)

Key words: Ecological land classification, wildlife habitat assessment, land evaluation

Alexander, M.E.; Janz, B.; Quintilio, D. 1983. Analysis of extreme wildfire behavior in east-central Alberta: a case study. Pages 38-46 in Proc. Seventh Conf. Fire For. Meteorol., April 25-28, 1983, Fort Collins, Colorado. Am. Meteorol. Soc., Boston, Massachusetts.

Forest fires in the Winefred Lake area during 1980 are reviewed. Included in the review is a summary of forest and meteorological conditions as they related to the fire. Some information is also provided on the fire history of the area. (Location: 73 M)

Key words: Fire ecology, fire management and effects, climate and related effects

Anderson, D.W.; Ellis, J.G. 1976. The soils of the provincial forest in the Prince Albert map area (73 H). Univ. Sask., Div. Ext. Community Relat., Sask. Inst. Pedol., Saskatoon, Saskatchewan. Publ. SF3.

A soil survey (1:126 720 scale) was conducted in a 5700-km² area located north and east of Prince Albert. Some profile descriptions and physical and chemical data are included,

as well as forestry and agricultural capability ratings. (Location: 73 H)

Key words: Soil survey, soil and site conditions, land evaluation

Anderson, H.G. 1976. The future forests of Saskatchewan. Ph.D. thesis, Univ. Sask., Saskatoon, Saskatchewan.

A biophysical analysis of 5570 km² was conducted to assess the long-term implications of forest harvesting in central Saskatchewan. The interpretation was stratified by land system (ecosection). Various pathways of stand development are presented to predict tree regeneration based on soil moisture conditions, conifer regeneration, and site productivity. (Location: 73 H)

Key words: Ecological land classification, forest-harvesting effects, ecology, soil and site conditions, soil and site productivity

Anderson, H.G. 1980. Ecological land classification and evaluation: Cache Percotte area. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. 142.

This report discusses the ecological land classification (1:15 000 scale) of the Cache Percotte school forest (65 km²) near Hinton, Alberta. This area is in the transition zone between the Lower and Upper Boreal-Cordilleran ecoregions. Descriptions are provided for ecosites (vegetation, soil, geomorphology, geology), along with Canada Land Inventory equivalent ratings for agriculture, forestry, ungulates, and waterfowl. Physical soil limitations are also provided for selected recreational uses. (Location: 83 F)

Key words: Ecological land classification, vegetation classification, land evaluation

Annas, R.M. 1977. Boreal ecosystems of the Fort Nelson area of northeastern British Columbia. Ph.D. thesis, Univ. B.C., Vancouver, British Columbia.

Not available for review. (Location: 94 J)

Key words: Vegetation classification, soil and site conditions

Annas, R.M.; Robertson, S.L.; Bentz, J.A.; Nemeth, Z.J. 1983. An ecosystem classification of the

Boreal Cordilleran ecozone, Sundre area. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta.

The purpose of this study was to develop an ecological zonation of forested lands between Sundre, Alberta, and Banff National Park. Most of the work involved sampling of vegetation and analysis of site conditions. The eastern portion of the study area included the Lower-Boreal-Cordilleran Ecoregion. Estimates of tree volume, site index, and mean annual increment are provided for each forest community. (Location: 82 O)

Key words: Vegetation classification, soil and site conditions, soil and site productivity

Apps, M.J.; Kurz, W.A.; Luxmoore, R.J.; Nilsson, L.O.; Sedjo, R.A.; Schmidt, R.; Simpson, L.G.; Vinson, T.S. 1993. Boreal forests and tundra. Water Air Soil Pollut. 70:39-53.

The relative importance of the boreal forest as a sink for atmospheric carbon is reviewed. Currently, the boreal forest zone is thought to be an accumulator of carbon (0.7 Pg C/yr). The authors suggest that limited potential exists for mitigating climatic change through forest management because only a small amount of the boreal zone is directly affected by forest harvesting. They also suggest that the long-term continuation of the boreal zone as a sink might not be possible due to an aging forest and changes in the disturbance regime. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Climate and related effects, pollution effects, fire ecology, forest-harvesting effects

Archibald, J.H. 1981. Forage inventory of the Rocky-North Saskatchewan study area. Alta. Energy Nat. Resour., Alta. For. Serv., Edmonton, Alberta. Tech. Rep. T/19-3.

A forage inventory (1:50 000) was conducted in the Rocky-North Saskatchewan study area (6950 km²). The paper identifies 31 forage types in the study area. Species composition and biomass data are presented. General site conditions are also provided for individual vegetation plots. (Location: 83 B, C, G)

Key words: Forest grazing, vegetation classification, vegetation assessment, wildlife habitat assessment

Archibald, J.H. 1982. Forage inventory of the Ram-Clearwater study area. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/19-5.

This report presents a forage inventory and analysis (1:50 000) for the Ram-Clearwater study area (3640 km²). The objectives were to identify species composition and determine the amount of biomass available for foraging and browsing. Sixteen forage types are recognized in the area. (Location: 83 C, B; 82 O)

Key words: Forest grazing, vegetation classification, vegetation assessment, wildlife habitat assessment

Archibald, J.H. 1986. Ecological zonation of northwestern Alberta. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Publ. T/136.

The zones and subzones of northwestern Alberta are mapped at a scale of 1:500 000 and described in terms of plant associations, soils, and regional climate. Keys to plant associations and descriptions of forest productivity are included. (Location: 83 M, N, O; 84 B-G, J-O)

Key words: Ecological land classification, vegetation classification, soil and site conditions, soil and site productivity

Archibald, J.H.; Ferguson, N.B.; Haag, R.W.; Hay, W.K.; O'Leary, D.J. 1984. An integrated resource inventory of Deep Basin area (NTS 83L): physical land classification, forage inventory and ecological land classification. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. T/78.

Three natural-resource inventories are provided for the area south of Grande Prairie: a physical land classification (1:50 000), an ecological land classification (1:100 000), and a forage inventory. Volume II contains vegetation plot data and a classification of plant communities. (Location: 83 L)

Key words: Ecological land classification, physical land classification and geology, vegetation classification, forest grazing

Archibald, J.H.; Klappstein, G.D.; Corns, I.G.W. 1996. Field guide to ecosites of southwestern Alberta. Nat. Resour. Can., Can. For. Serv.,

Northwest Reg., North. For. Cent., Edmonton, Alberta. Spec. Rep. 8.

An ecosystematic-based classification of sites was developed for the forest portion of southwest Alberta. Plant communities were initially stratified according to climatic zone, soil moisture and nutrient regimes, and then subdivided on the basis of over- and understory vegetation types. A total of 148 community-types are recognized among four climatic zones. General species-composition summaries are provided for individual community-types. A generalized soil-classification system based on texture and moisture classes is also presented. (Location: 82 H, G, J, N, O; 83 B, C)

Key words: Vegetation classification, soil and site conditions, land evaluation

Archibold, O.W. 1979. Buried viable propagules as a factor in post-fire regeneration in northern Saskatchewan. Can. J. Bot. 57:54-58.

The objective of this study was to determine the amount of viable seed in a mixedwood stand that was burnt in 1977, and to evaluate its role in forest regeneration. The rate of emergence represented 426 plants/m², 87% originated from seed and 13% developed from roots or rhizomes. Approximately 456 propagules/m² occurred, with trees accounting for 43% of the total seed input that originated from the surrounding undisturbed forest. (Location: 73 I)

Key words: Fire ecology, vegetation assessment, ecology

Archibold, O.W. 1980. Seed input into a postfire forest site in northern Saskatchewan. Can. J. For. Res. 10:129-134.

The quantity of seed transported into a burned, even-aged aspen-white spruce stand was monitored during the early regrowth stage to evaluate the recovery of the forest cover. The equivalent of approximately 9 million seeds/ha was collected in seed traps. The most abundant species were fireweed (65%), paper birch (28%), and white spruce (6%). During the second year of growth, seed counts from traps decreased to 3.4 million/ha. Much of the early growth originated from vegetative reproduction. (Location: 73 I)

Key words: Fire ecology, vegetation assessment

Argus, G.W.; Pryer, K.M. 1990. Rare vascular plants in Canada: our national heritage. Can. Mus. Nat., Ottawa, Ontario.

A listing of significant plant species in Canada is presented. Nature Conservancy rarity ratings are given for individual species on a global and Canadian priority basis. Ratings of rarity are based on the number of known occurrences for each species. (Location: Canada)

Key words: Unique resources

Ayres, K.W.; Anderson, D.W.; Ellis, J.G. 1978. The soils of the northern provincial forest in the Pasquia Hills and Saskatchewan portion of The Pas map areas (63E and 63F). Univ. Sask., Sask. Inst. Pedol., Saskatoon, Saskatchewan. Publ. SF4.

A soils inventory was conducted in an area located east of Prince Albert (13 057 km²) and 1:126 720-scale maps depicting soil associations were prepared. Ratings are developed for forestry and agriculture. Area estimates are provided for each soil association as well as detailed physical and chemical analysis data for selected associations. (Location: 63 E, F)

Key words: Soil survey, soil and site conditions, land evaluation

Baker, J. 1973. Nitrogen fractionation of two forest soils in Alberta. Can. Dep. Environ., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-63.

The purpose of this study was to obtain information about nitrogen fractionation in soil horizons and its distribution within two forest soils, Mercoal (Brunisolic Gray Luvisol) and Coalspur (Orthic Gray Luvisol). Generally, both soils responded similarly to fertilization, but absolute values differed. (Location: 83 F)

Key words: Soil and site conditions

Baker, J.; Hocking, D.; Nyborg, M. 1977. Acidity of open and intercepted precipitation in forests and effects on forest soils in Alberta, Canada. Water Air Soil Pollut. 7:449-460.

The effects of sulfur-dioxide-acidified precipitation on soil properties were examined. The results found increased acidity and aluminum levels, and decreased calcium and magnesium

contents. The study concludes that acidification removes nutrients from the soil. (Location: 83 B; 74 D, E)

Key words: Pollution effects, soil and site conditions, climate and related effects

Ball, W.J. 1990. Site preparation affects white spruce seedling performance after 20 years. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Manage. Note 47.

The effects of blading are reviewed by assessing a specific experiment. Blading was found to have a negative affect on white spruce 21-23 years old. Although blading reduced the severity of aspen competition, height and leader length were reduced compared to unbladed sites. (Location: 62 K)

Key words: Vegetation control—mechanical, site preparation, aspen, white spruce

Ball, W.J.; Kolabinski, V.S. 1979. An aerial reconnaissance of softwood regeneration on mixed-wood sites in Saskatchewan. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-216.

This study used large-scale (1:830 scale) color photos to assess conifer regeneration in deciduous forests. The results strongly indicate that the use of remote sensing was favorable from both economical and operational perspectives. The authors warn that softwood timber supplies were being depleted. (Location: 63 E)

Key words: Remote sensing, reforestation, white spruce

Ball, W.J.; Kolabinski, V.S. 1986. Performance of container and bare-root stock on prescribed burns in Saskatchewan. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-283.

Container and bare-root jack pine and white spruce seedling survival, height growth, and annual increment were evaluated on prescribed burn sites after 5 years of growth. Survival rates were high (85%) for both species, while height growth was better for bare-root than container stock. Planting of bare-root stock in fall rather than spring is not recommended by the authors due to variable survival. (Location: 73 H)

Key words: Reforestation, tree-crop production, white spruce, jack pine

- Ball, W.J.; Walker, N.R. 1995. Natural regeneration of white spruce after partial cutting and strip scarification in mature mixed white spruce-aspen stands, Manitoba. Nat. Resour. Can., Can. For. Serv., Manit. Dist. Off., Winnipeg, Manitoba, and Manit. Nat. Resour., For. Branch, Winnipeg, Manitoba. Can.-Manit. Partnership Agreement For. Rep.**

Six partial cuts with different proportions of hardwood and softwood removal and different final densities were tested to evaluate white spruce establishment rates. Site preparation involved strip scarification by blading. Initially, all treatments produced high levels of white spruce establishment. By 37 years after treatment, however, levels had declined significantly, although stands were still considered to be adequately stocked. Treatments involving a 60–80% removal of softwoods, but no hardwoods, produced high levels of stocking, and 80% softwood removal resulted in the best height growth of the tested treatments. Differences in success were also related to soil moisture regime. The use of herbicides was not found to have had a long-term negative effect and, in some cases, resulted in better white spruce regeneration. (Location: 62 O; 63 B)

Key words: Forest harvesting effects, white spruce, reforestation, vegetation control—chemical, site preparation

- Basham, J.T. 1987. Assessment and prediction of stem decay in aspen stands. Pages 110–125 in Proc. Aspen Quality Workshop., February 12, 1987, Edmonton, Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. For. Lands Wildl., Alta. For. Serv., Edmonton, Alberta. Can.-Alta. For. Resour. Dev. Agreement Rep.**

This research suggests that age is a more reliable indicator of stem decay in aspen than diameter, growth rate, or site. In Manitoba and Ontario, superior clones were rare, and faster-growing clones usually had the most stem decay. Aspen clones had more influence on the amount of decay than site. *Phellinus tremulae* caused about 70% of stem decay in aspen, and the presence of its conks on stems was the most

reliable indicator of decay. (Location: Ontario, Manitoba)

Key words: Forest damage agents, aspen, genetics and cellular structure

- Bayrock, L.A. 1971. Surficial geology Bitumont, NTS 74E. Res. Counc. Alta., Edmonton, Alberta. Alta. Geol. Surv. Maps 140.**

A 1:250 000-scale map of surficial deposits was developed in an area immediately north of Fort McMurray. A brief description that focuses on textural composition is provided for the broadest types of surficial materials. (Location: 74 E)

Key words: Physical land classification and geology

- Bayrock, L.A. 1972a. Surficial geology Fort Chipewyan, NTS 74L. Res. Counc. Alta., Edmonton, Alberta. Alta. Geol. Surv. Maps 141.**

A 1:250 000-scale map of surficial deposits was developed for an area at the southern end of Wood Buffalo National Park. A brief description that focuses on textural composition is provided for the broadest types of surficial materials. (Location: 74 L)

Key words: Physical land classification and geology

- Bayrock, L.A. 1972b. Surficial geology Lake Claire, NTS 84I. Res. Counc. Alta., Edmonton, Alberta. Alta. Geol. Surv. Maps 144.**

A 1:250 000-scale map of surficial deposits was developed for an area at the southern end of Wood Buffalo National Park. A brief description that focuses on textural composition is provided for the broadest types of surficial materials. (Location: 84 I)

Key words: Physical land classification and geology

- Bayrock, L.A. 1972c. Surficial geology Peace Point and Fitzgerald west of 111E20', NTS 84P and 74M. Res. Counc. Alta., Edmonton, Alberta. Alta. Geol. Surv. Maps 145.**

A 1:250 000-scale map of surficial deposits was developed for an area in the east-central

portion of Wood Buffalo National Park. A brief description that focuses on textural composition is provided for the broadest types of surficial materials. (Location: 84 P; 74 M)

Key words: Physical land classification and geology

Bayrock, L.A.; Reimchen, T.H.F. 1974. Surficial geology waterways, NTS 74D. Res. Counc. Alta., Edmonton, Alberta. Alta. Geol. Surv. Maps 148.

A 1:250 000-scale map of surficial deposits was developed for an area in the vicinity of Fort McMurray. A brief description that focuses on textural composition is provided for the broadest types of surficial materials. (Location: 74 D)

Key words: Physical land classification and geology

Beak Associates Consulting Ltd. 1987. A prototype assessment of wildlife resource status of the Wapiti (83L) NTS map sheet. Alta. For. Lands Wildl., Fish Wildl. Div., Calgary, Alberta.

Numerical models were developed for various wildlife species (moose, sheep, deer, woodland caribou) as a basis for rating habitat quality. Habitat suitability was calculated by assigning weights to various variables such as snow depth and food availability. (Location: 83 L)

Key words: Wildlife habitat assessment, climate and related effects, ungulates

Beckingham, J.D. 1990. The influence of microclimate and grazing on the growth of *Lathyrus ochroleucus* (Hook.) in central Alberta. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

Microclimatic factors such as soil temperature and soil moisture were monitored to determine their effect on the growth of *Lathyrus ochroleucus* (cream-colored vetchling). Mesoclimatic factors were found to be more important than microclimatic conditions for controlling growth. (Location: 83 H)

Key words: Forest grazing, climate and related effects, soil and site conditions, ecology

Beckingham, J.D. 1991. Grazing in the boreal mixed-wood ecoregion Alberta: literature review.

Alta. For. Lands Wildl., Public Lands Div., Peace River, Alberta.

This report is a literature review of various topics related to grazing in native boreal mixed-wood forests. Among the topics covered are the amount and quality of forest forage, factors affecting quality and quantity, management considerations, and common plant community-types found in the boreal mixedwood ecoregion. The report also contains an extensive annotated literature list. (Location: Alberta)

Key words: Forest grazing, ecology, vegetation assessment, soil and site conditions

Beckingham, J.D.; Archibald, J.H. 1996. Field guide to ecosites of northern Alberta. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. Spec. Rep. 5.

An ecosystematic-based classification of sites was developed for the boreal forest portion of Alberta, which represents more than half of province. Included in the classification are highlands, Canadian shield, and subarctic areas as well as boreal mixedwood landscapes. Plant communities were initially stratified according to climatic zone, soil moisture, and nutrient regimes, and then subdivided on the basis of over- and understory vegetation types. A total of 129 community-types are recognized within four climatic zones. General species composition summaries are provided for individual community-types. A generalized soil-classification system is also presented, based on texture and moisture classes. (Location: Alberta)

Key words: Vegetation classification, soil and site conditions, land evaluation

Beckingham, J.D.; Corns, I.G.W.; Archibald, J.H. 1996. Field guide to ecosites of west-central Alberta. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. Spec. Rep. 9.

An ecosystematic-based classification of sites was developed for the cordilleran and boreal-cordilleran zones along the eastern slopes of the Rock Mountains in Alberta. Plant communities were initially stratified according to climatic zone, soil moisture and nutrient regimes, and then subdivided on the basis of

over- and understory vegetation types. A total of 226 community-types are recognized within four climatic zones. General species composition summaries are provided for individual community-types. A generalized soil-classification system is also presented, based on texture and moisture classes. (Location: 83 B, C, E, F, J, K, L, M; 84 C, D, E)

Key words: Vegetation classification, soil and site conditions, land evaluation

Beckingham, J.D.; Nielsen, D.G.; Futoransky, V.A. 1996. Field guide to ecosites of the mid-boreal ecoregions of Saskatchewan. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. Spec. Rep. 6.

An ecosystematic-based forest classification of boreal mixedwood sites was developed for the central portion of Saskatchewan. Plant communities were initially stratified according to soil moisture and nutrient regimes, and then subdivided on the basis of over- and understory vegetation types. A total of 78 different community-types are recognized among 13 different soil moisture and nutrient regimes. General species composition summaries are provided for individual community-types. (Location: 63 D, E; 73 F, G, H, J, K, N; 74 C, F)

Key words: Vegetation classification, soil and site conditions, land evaluation

Beke, G.J. 1969. Soils of three experimental watersheds in Alberta and their hydrologic significances. Ph.D. thesis, Univ. Alta., Edmonton, Alberta.

This study describes, classifies, and maps soils in three headwater basins for the purpose of determining their importance in the hydrologic cycle for watershed management purposes. Data on parent materials and soil-profile descriptions are provided. (Location: 82 O)

Key words: Hydrology, soils survey, soil and site conditions

Bella, I.E. 1968. Estimating aerial component weights of young aspen trees. Can. Dep. Fish. For., For. Branch, For. Res. Lab., Winnipeg, Manitoba. Inf. Rep. MS-X-12.

The aboveground biomass of young aspen was determined in relation to stand density, site, and clonal variation in pure, even-aged stands growing on fresh sites. The report presents regression equations and tables for estimating tree component quantities. (Location: 62 K; 63 D)

Key words: Growth and yield, aspen, even-aged stand management

Bella, I.E. 1969. Competitive influence-zone overlap: a competition model for individual trees. Can. Dep. Fish. For., For. Branch, Ottawa, Ontario. Bi-mon. Res. Notes 25:24-25.

Regression equations for aspen and jack pine were developed to evaluate competition among individual trees based on dependent variables such as crown radius and diameter at breast height. The author concludes that the tested method produced results comparable to other methods available at the time. (Location: Not specified)

Key words: Competition analysis, aspen, jack pine, growth and yield

Bella, I.E. 1970. Simulation of growth, yield and management of aspen. Ph.D. thesis, Univ. B.C., Vancouver, British Columbia.

Regression models for predicting aspen growth and yield were developed for above-average-quality stands. Diameter at breast height and stem age were found to be the most useful variables used in equations to estimate basal area, volume, and weights per area. The mathematical relationship among tree components (e.g., leaves, branches, stems) was also assessed. (Location: Saskatchewan, Manitoba)

Key words: Growth and yield, tree-crop production, aspen

Bella, I.E. 1972. Logging practises and the development of new aspen stands. Environ. Can., For. Serv., North. For. Res. Cent., Edmonton, Alberta. For. Rep. 2:(2)5-6.

Various logging techniques were compared in the Hudson Bay area of Saskatchewan. The study finds that aspen sucker densities were twice as great after logging in summer than in winter, more suckers developed where slash was less, high densities of suckers resulted in a

greater proportion of mortality, and the season of logging did not affect stand species composition. (Location: 63 E)

Key words: Forest-harvesting effects, vegetation control—mechanical, aspen

Bella, I.E. 1975. Growth-density relations in young aspen sucker stands. *Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-124.*

This study examines the effect of density on tree growth in juvenile stands. The aim of the study was to improve growth and yield-prediction techniques. Results suggest that stand density has a significant affect on growth, and diameter increment can be halved by crowding. To improve diameter increment, thinning was recommended. (Location: 63 E)

Key words: Growth and yield, juvenile stand-tending, aspen

Bella, I.E. 1986a. Logging practices and subsequent development of aspen stands in east-central Saskatchewan. *For. Chron.* 62:81–83.

This study began in 1965 to determine the effects of various logging practices on aspen sucker densities and subsequent stand development. It describes the growth and stand development trends at 17 years after logging. The study shows that there was excellent stocking and density following both summer and winter logging. Logging slash on the ground resulted in stands with densities comparable to the fire-origin regeneration. (Location: 63 E)

Key words: Forest-harvesting effects, growth and yield, aspen

Bella, I.E. 1986b. Tree growth response along seismic lines in Alberta. *For. Chron.* 62:29–34.

This study shows that aspen growth was not stimulated along seismic cut lines, which represented a complete loss of tree production on these disturbances. Following clearing the radial increment for lodgepole pine, white spruce, and black spruce increased. No consistent trend was found for aspen. The increase in growth did not replace the loss resulting from clearing. (Location: 83 B, F, G, K, L)

Key words: Environmental impacts, growth and yield

Bella, I.E.; De Franceschi, J.P. 1972. The effect of logging practices on the development of new aspen stands, Hudson Bay, Saskatchewan. *Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-33.*

The effects of aspen harvesting were assessed with respect to the quantity of suckers produced after summer and winter harvesting. Results indicate that more suckers are produced after summer harvesting. Stem densities ranged from 6600 to 92 900/ha. (Location: 63 E)

Key words: Forest-harvesting effects, aspen, growth and yield

Bella, I.E.; De Franceschi, J.P. 1980a. Biomass productivity of young aspen stands in western Canada. *Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-219.*

The purpose of this study was to determine the biomass represented by various components of aspen trees from the time of establishment to 40 years old on a range of sites at various densities. Equations and tables are provided for estimating aboveground dry-weight tree components in Alberta and Saskatchewan. From 10 to 40 years the proportion of stem wood increases by 60–70%, with a corresponding drop in the proportion of bark, branches, and leaves. This study recommends a rotational age of approximately 30 years for fully stocked normal stands. (Location: 63 D, E; 73 G, H, K, L, M; 83 O, P)

Key words: Growth and yield, tree-crop production, aspen

Bella, I.E.; De Franceschi, J.P. 1980b. Site index curves for aspen in the prairie provinces. *Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. For. Manage. Note 1.*

Aspen site index regression models were developed for mixedwood forests of western Canada. The models included site index curves at 2-year intervals from 12 to 22 m based on a reference age of 50 years. The curves were limited to aspen between 10 and 80 years old. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Growth and yield, aspen

Bella, I.E.; Gál, J. 1996. Growth, development, and yield of mixed-wood stands in Alberta following partial cutting of white spruce. *Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-346.*

This study analyzes data from permanent white spruce growth plots established in 121 partially logged and 90 undisturbed sites. These plots were installed in 1951/52 and 1962, respectively. The results showed that 5- to 20-cm diameter trees responded positively to harvesting during the first few years, but larger trees did not. A positive response was also found with increasing soil moisture availability. Aspen volumes increased most on sites where they were not the most abundant tree in preharvest condition. (Location: 83 B, F, G, J, O)

Key words: Growth and yield, white spruce, forest-harvesting effects, uneven-aged stand management

Bella, I.E.; Hunt, K. 1973. Kraft pulping of young trembling aspen from Manitoba. *Can. J. For. Res. 3:359-366.*

This study was conducted to determine how yield and quantity of kraft pulp are affected by tree age. The results suggest that aspen trees that are 7, 13, and 22 years old can produce market pulp with good yields and comparable strengths; however, costs of harvesting, bark removal, and chipping will vary among the three age groups. (Location: 62 K; 63 F)

Key words: Economics—fiber, tree-crop production, aspen

Bella, I.E.; Jarvis, J.M. 1967. High total productivity of a young aspen stand in Manitoba. *Woodlands Rev. 68:432-437.*

This study finds that short-rotation management of aspen can provide a quick return on investment and fill future demands for fiber. The results also suggest that young stands contain considerable volume, assuming that vegetation competition is controlled and fertilizers are applied. (Location: Manitoba)

Key words: Economics—fiber, aspen, forest-harvesting effects, growth and yield

Bentz, J.; Brierley, D.; Hay, W.; Nelson, S.; Robertson, S.; Wehrhahn, R. 1985. Integrated resource inventory of Coal Branch study area. *Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/83-1 and 2.*

An integrated-resource inventory was conducted in the Coal Branch planning area (8100 km²) to provide a common basis for land-use evaluation. An ecological (1:100 000), physical (1:50 000), and vegetation classification were developed. The report summarizes the relationships among the basic environmental components. (Location: 83 C, F)

Key words: Ecological land classification, physical land classification and geology, vegetation classification, soil and site conditions, ecology

Bentz, J.; Johnson, M.; Brierley, D. 1985. Ecosystem classification and forest capability of the McLeod River coal lease. *Alta. Energy Nat. Resour., Edmonton, Alberta.*

This report describes an ecosystem classification of the McLeod River coal lease area (1830 ha). The ecosystem units were mapped at a scale of 1:15 000. The study includes an inventory of vegetation, soils, and mensurational data. Forest capability of the area was determined through a variety of methods. (Location: 83 F)

Key words: Ecological land classification, soil and site conditions, tree-crop production, land evaluation

Bessie, K.; Knapik, L.J.; McCann, A.M. 1986. Physical land classification of the management unit W4. *Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/111.*

A physical land classification (1:15 000) was developed for the W4 forest management unit (1305 km²). The area was first divided into physiographic units and then further subdivided into land units. Each physical classification unit was described in terms of its physiography, geomorphology, surface characteristics, and soils. (Location: 83 K)

Key words: Physical land classification and geology, soil and site conditions

Bichlmaier, M. 1985. Response of understory vegetation of some boreal mixedwood forest communities to native ungulate foraging. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

The response of various plant communities was examined in relation to high and low levels of native ungulate use. Preferred browse/grazing species included *Viburnum edule*, *Prunus virginiana*, *Amelanchier alnifolia*, *Aralia nudicaulis*, *Epilobium angustifolium*, and *Disporum trachycarpum*, but these species were usually less abundant due to browsing or grazing. Bristly and spiny shrubs and introduced weeds increased due to their less preferred status. (Location: 83 H)

Key words: Vegetation assessment, wildlife habitat assessment, forest grazing, ungulates

Bishoff, K.W. 1981a. Forage inventory of the Jean D'Or Prairie study areas. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/19-1.

This report presents the results of a forage inventory (1:50 000) that was conducted in the Fort Vermilion area (1495 km²). Fourteen forage types are recognized. For each type, species composition and herbaceous biomass data are summarized. (Location: 84 J)

Key words: Forest grazing, vegetation classification, vegetation assessment

Bishoff, K.W. 1981b. Yield, use and chemical composition of forage in Elk Island National Park. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

This study assessed the habitat and forage resources within an enclosed 723-ha area that was heavily stocked with moose and elk. The objective of the study was to classify and describe the vegetation, determine forage yield and chemical composition, and describe resource use. In general, annual herbaceous forage and current annual growth of browse provided adequate nutrients, but 2- to 3-year-old wood was probably nutrient-deficient. (Location: 83 H)

Key words: Wildlife habitat assessment, forest grazing, vegetation classification, vegetation assessment

Bishoff, K.W. 1984. Forage inventory of the Frost Hills study area. Revised by D.J. Downing.

Alta. Energy Nat. Resour., Alta. For. Serv., Edmonton, Alberta. Tech. Rep. T/19-6.

A forage inventory was conducted in an area located along the south side of Lesser Slave Lake (1212 km²). Sixteen forage types are recognized, described, and mapped (1:50 000), including deciduous, coniferous, and wetland types. Raw vegetation data are also provided. (Location: 83 O)

Key words: Forest grazing, vegetation classification, vegetation assessment

Blenis, P.V.; Titus, S.J.; Mallet, K.I. 1995. Impact of *Armillaria* root rot in intensively managed white spruce/aspen stands. Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Land For. Serv., Edmonton, Alberta. Can.-Alta. Partnership Agreement For. Rep. 129.

This study evaluates the effects of *Armillaria* on the growth and yield of various mixtures and densities of aspen and white spruce. This brief report summarizes the experimental design and the preliminary results of a 20-year study. Initial results indicated that *Armillaria* was common in all experiment plots. Remeasurement of the stands is scheduled to occur at 3-year intervals. (Location: Western Alberta)

Key words: Forest damage agents, growth and yield, aspen, white spruce

Bonan, G.B.; Pollard, D.; Thompson, S.L. 1992. Effects of boreal forest vegetation on global climate. *Nature* 359:716-718.

The authors model the potential climatic effects resulting from deforestation of the boreal forest. Results suggest that large-scale deforestation could result in temperature-regime changes due to differences in solar radiation absorption. Under the authors' model, both summer and winter temperatures in the boreal forest would be cooler without a tree cover. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Climate and related effects, pollution effects, forest-harvesting effects

Bonnor, G.M. 1982. Canada's forest inventory 1981. Can. Dep. Environ., Can. For. Serv., For. Stat. Syst. Branch, Chalk River, Ontario.

Various statistics on Canadian forests are presented. These include percentage area of land and water; forested land, productive forest land, wood volumes, ownership, proportion of stocked and productive forest by age class and total areas; and volume of softwood by province. (Location: Canada)

Key words: Tree-crop production, economics—fiber

Bovar Environmental. 1996. Environmental impact assessment for the Syncrude Canada Limited Aurora Mine. Syncrude Canada, Edmonton, Alberta.

This report assesses the impact of a proposed open-pit mine located in an area north of Fort McMurray. The report contains a variety of baseline environmental information, including climate, terrain, soils, hydrology, vegetation, plant community-types, and wildlife resources. (Location: 74 E)

Key words: Environmental impacts, vegetation assessment, soil and site conditions, wildlife habitat assessment, physical land classification and geology

Boyacioglu, E. 1974. Biophysical analysis and evaluation of capability: Wolf Lake area. Alta. Lands. For., Land Use Assign. Comm., Edmonton, Alberta.

The biophysical resources of a 560-km² area near Wolf Lake are organized into a 1:63 360-scale ecological classification and summarized. The classification is strongly weighted toward soil and geomorphic attributes. Canada Land Inventory ratings are provided for agriculture, forestry, recreation, and wildlife resources. This classification was revised by Ojamaa (1977). (Location: 73 L)

Key words: Ecological land classification, land evaluation

Boyacioglu, E. 1975. Biophysical analysis and evaluation of capability: Fort Assiniboine. Alta. Energy Nat. Resour., Land Use Assign. Comm., Edmonton, Alberta.

A biophysical classification (1:126 720) was developed for an area near Fort Assiniboine. This analysis is strongly oriented toward physical resources. Each ecosection (land system)

was rated for agriculture, forestry, ungulates, recreation, and waterfowl capability. (Location: 83 J, K)

Key words: Ecological land classification, land evaluation

Boyacioglu, E; Van Waas, C. 1973. Biophysical analysis and evaluation of capability: Edson-Peers. Alta. Lands For., Land Use Assign. Comm., Edmonton, Alberta.

This report presents a biophysical classification of the Edson-Peers area. Each ecosection (land system) is described in terms of physiography, soil association, present use, natural cover, and agroclimate zones. Suitability ratings are provided for agriculture, forestry, ungulates, recreation, and waterfowl. Also included are land-capability maps (1:50 000). (Location: 83 F, K)

Key words: Ecological land classification, land evaluation

Boyd, M.G. 1978. Management of marten, fisher, and lynx in Saskatchewan with special reference to the effects of forest harvesting in the mixedwood boreal forest. M.E.Des. thesis, Univ. Calgary, Calgary, Alberta.

The primary objective of this thesis was to review furbearer-management practices to improve strategies for marten, fisher, and lynx. The author concludes that insufficient information existed to manage these species properly, that marten and lynx populations should not be trapped during years of low numbers, and that the fisher trapping season should be shortened. Forest harvesting displaces marten, lynx, and fisher, with the two latter species re-occupying an area within 1–20 years after disturbance. Marten require much longer periods of time due to the lack of suitable vegetation. (Location: Saskatchewan)

Key words: Wildlife distribution and diversity, wildlife-habitat assessment, forest-harvesting effects, furbearers

Boydell, A.N.; Bayrock, L.A.; Reimchen, T.H.F. 1974. Surficial geology Rocky Mountain House (NTS 83B). Res. Coun. Alta., Edmonton, Alberta. Alta. Geol. Surv. Maps 146.

This paper provides a 1:250 000-scale map of surficial materials in the Rocky Mountain House area of Alberta. A brief description that focuses on textural composition is provided for the broadest types of surficial materials. (Location: 83 B)

Key words: Physical land classification and geology

Brace, L.G. 1990. A test of three logging systems in Alberta. Can. For. Ind. 110(8):24-29.

Various approaches to mixedwood-stand harvesting were tested to assess the costs and benefits of different levels of understory white spruce protection. The author concludes that a substantial amount of understory white spruce could be protected using standard equipment, if an effort were made to do so. (Location: 83 F, G, J)

Key words: Forest-harvesting effects, understory protection, white spruce, aspen

Brace, L.G. 1991. Protecting understory white spruce when harvesting aspen. Pages 116-128 in A. Shorttreid, ed. Northern mixedwood '89. Proc. Symp., September 12-14, 1989, Fort St. John, British Columbia. For. Can., Pac. Yukon Reg., Pac. For. Cent., Victoria, British Columbia. FRDA Rep. 164.

This paper presents a two-stage tending and harvesting model for boreal mixedwood stands for the protection and release of white spruce understories during aspen harvesting. Several harvesting systems are compared with respect to their effects on spruce damage and mortality. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-harvesting effects, understory protection, aspen, white spruce

Brace, L.G.; Bella, I.E. 1988. Understanding the understory: dilemma and opportunity. Pages 69-86 in J.K. Samoil, ed. Management and utilization of northern mixedwoods. Proc. Symp., April 11-14, 1988, Edmonton, Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-296.

This article deals with the economic value and potential of boreal mixedwood forest stands. Options are discussed for protecting the white spruce understory component of aspen stands during harvesting. The authors suggest

that protection of the understory white spruce has long-term economic value, but systematic inventories are required to improve planning. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Economics—fiber, forest-harvesting effects, understory protection

Brace Forest Services. 1992. Protecting white spruce understories when harvesting aspen, progress report. For. Can., North. For. Cent., Edmonton, Alberta, and Alta. For. Lands Wildl., Alta. For. Serv., Edmonton, Alberta. Can.-Alta. Partnership Agreement For. Rep. 102.

This study evaluates the feasibility of protecting white spruce understory regeneration during forest harvesting. Included in the assessment are considerations of harvesting damage, growth and yield responses, blow-down risk, and natural regeneration, as well as training and operation costs and benefits. The author provides several recommendations for additional study. (Location: 83 F, K)

Key words: Understory protection, economics—nonfiber, economics—fiber, uneven-aged stand management, white spruce, forest-harvesting effects

Brandt, J.P. 1994a. Gypsy moth. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 29.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of gypsy moths. (Location: Canada)

Key words: Forest-damage agents, pest control

Brandt, J.P. 1994b. Wood borers in hardwoods. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 31.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agents; and prevention and control of wood borers in hardwoods. (Location: Canada)

Key words: Forest-damage agents, pest control

Brierley, D.; Downing, D.; O'Leary, D. 1985. Integrated resource inventory of the Keg River

study area. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/87.

Volume I of this report presents a physical (1:50 000 scale) and ecological (1:100 000) land classification for the Keg River area (1350 km²). A general description is provided for each major physiographic unit and ecosection. Various capability ratings are developed for agriculture, forestry, and wildlife. Volume II summarizes a vegetation classification. (Location: 84 F)

Key words: Ecological land classification, physical land classification and geology, vegetation classification, land evaluation

Brocke, L.K. 1976. Biophysical analysis and evaluation of capability: Clear River area. Alta. Energy Nat. Resour., Land Use Assign. Comm., Edmonton, Alberta.

This report presents a biophysical analysis (1:126 720) for the Clear River area, located north of Grande Prairie. Physical and general biological resources are summarized for each ecosection (land system). Capability ratings are developed for agriculture, forestry, ungulates, recreation, and waterfowl. (Location: 84 D)

Key words: Ecological land classification, land evaluation

Brown, K.M.; Navratil, S. 1995. Analysis and interpretation of the research microsite projects in Alberta. Effects of silvicultural and environmental factors on the post-planning performance of crop trees and competing vegetation. Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot. Land For. Serv., Edmonton, Alberta. Can.-Alta. Partnership Agreement For. Rep. 138.

This study statistically evaluates the quality of planting sites and the effect of competing vegetation on seedling survival and growth as it relates to various site-preparation tools. Results suggest that total seedling height tended to be better from Marttiini plows than from Bracke/Sinkilla Spot or Bracke mounder treatments, and, on mesic sites, the top of the mound was better than the hinge. Forb and grass competition were found to have significant impact on seedling growth, while weaker

relationships were associated with the number of deciduous stems in the area around seedlings. Proper interpretation of these results requires further study. (Location: Alberta)

Key words: Competition analysis, white spruce, lodgepole pine, site preparation, vegetation control—mechanical, growth and yield

Brown, K.R. 1989. Effects of nitrogen availability and CO₂ enrichment on growth, water use, and nutrition of seedlings of boreal trees. Ph.D. thesis, Univ. Alta., Edmonton, Alberta.

This study examines the effects of atmospheric carbon dioxide enrichment on aspen and white spruce seedling growth. Results indicate that exposure to increased carbon dioxide levels increases mass, height, and leaf area of aspen for a short period of time (60 days). Nutrient availability was an important factor in increased growth. *Also see* Brown and Higginbotham (1986). (Location: Not applicable; laboratory study)

Key words: Pollution effects, climate and related effects, soil and site conditions, aspen, white spruce

Brown, K.R.; Higginbotham, K.O. 1986. Effects of carbon dioxide enrichment and nitrogen supply on growth of boreal tree seedlings. Tree Physiol. 2:223-232.

This study characterizes the growth and biomass partitioning of white spruce and aspen seedlings in response to controlled concentrations of atmospheric carbon dioxide and nitrogen supply. Nitrogen supply had pronounced effects on biomass accumulation, height, and leaf area of both species. (Location: Not applicable; laboratory study)

Key words: Pollution effects, climate and related effects, soil and site conditions, aspen, white spruce

Bulmer, C.E. 1987. Nutrient imbalances of aspen poplar in acid sulfate soils in northwestern Alberta. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

This study describes forest-soil interactions in a soil developed on extremely acidic parent materials in northwestern Alberta. Results show that nutrient concentrations in leaves are

similar to average values reported in the literature, despite the acidic conditions. (Location: 84 C)

Key words: Soil and site conditions, aspen, vegetation assessment

Burns, R.M.; B.H. Honkala, B.H. eds. 1990. Silvics of North America: Vol. 1. Conifers and Vol. 2. Hardwoods. U.S. Dep. Agric., For. Serv., Washington, D.C. Agric. Handb. 654.

A general overview is given of various tree species. Among the topics are distribution, life history, site requirements, reproduction, typical growth and yield rates, and associated pests and diseases. A brief bibliography is also included for each species. (Location: North America)

Key words: Aspen, balsam poplar, white birch, white spruce, black spruce, jack pine, lodgepole pine, balsam fir, soil and site conditions, growth and yield, forest-damage agents

Cairns, A.L. 1976. Distribution and food habits of moose, wapiti, deer, bison, and snowshoe hare in Elk Island National Park, Alberta. M.Sc. thesis, Univ. Calgary, Calgary, Alberta.

The habitat preferences of moose, bison, elk, and deer were investigated in Elk Island National Park. The principal habitats of moose were found to be shrublands and shrub meadows; bison preferred upland grasses, but used sedge and shrub meadows; elk primarily used grasslands, but also used willows and sedges in their winter and spring diets, respectively; and deer favored upland graminoids in spring and summer, and shrubs in winter. (Location: 83 H)

Key words: Wildlife-habitat assessment, vegetation assessment, ungulates

Cairns, A.L.; Telfer, E.S. 1980. Habitat use by four sympatric ungulates in boreal mixedwood forest. J. Wild. Manage. 44:849-857.

This study evaluates habitat selection by moose, white-tailed deer, elk, and bison. These species differed in their use of habitat types in terms of time spent and type of winter use. Bison and elk preferred uplands, and moose preferred shrublands and sedge meadows. (Location: 83 H)

Key words: Wildlife-habitat assessment, wildlife distribution and diversity, ungulates

Caltrell, R.M.; Amirault, P.A. 1991. Cooley spruce gall adelgid. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet 6.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of Cooley spruce gall adelgid. (Location: Canada)

Key words: Forest-damage agents, white spruce, pest control

Cameron, T.F. 1977. Biophysical analysis and evaluation of capability: La Crete area. P. 11a. Energy Nat. Resour., Land Use Assignment Branch, Edmonton, Alberta.

A biophysical analysis was conducted in the La Crete area (3300 km²). The classification has strong orientation toward physical resources. The natural resources of the study area are summarized and Canada Land Inventory ratings are developed for agriculture, forestry, recreation, ungulates, and waterfowl. (Location: 84 G)

Key words: Ecological land classification, land evaluation

Campbell, G.A.; Dunfield, J.D. 1969. Report on the forest survey of the Peter Pond Indian Reserve No. 193. Can. Dep. Fish. For., For. Manage. Inst., Ottawa, Ontario.

A forest mapping and inventory was conducted in the Peter Pond Indian Reserve area. Aspen and balsam poplar represented approximately 55% of the total tree volume. (Location: 73 N)

Key words: Tree-crop production, economics—fiber, aspen, balsam poplar

Campbell, J.S.; Lieffers, V.J.; Pielou, E.C. 1985. Regression equations for estimating single tree biomass of trembling aspen: assessing their applicability to more than one population. For. Ecol. Manage. 11:283-295.

The study recommends the use of existing equations to estimate biomass when models are lacking for a specific area. This could be accomplished by matching measured tree parameters to existing equations. The following five

descriptors would be necessary in selecting the appropriate existing regression equation: mean diameter at breast height; mean height; mean diameter at breast height/height ratio; mean absolute form quotient; and mean wood density. (Location: 74 E)

Key words: Growth and yield, aspen

- Campbell, L.M.; Bilodeau, R.J.; DeBoo, R.F. 1969.** Research on the poplar bud-gall mite in the prairie provinces. Can. Dep. Fish. For., For. Branch, For. Res. Lab., Winnipeg, Manitoba. Intern. Rep. MS-96.

The life history, distribution, and possible control of poplar bud-gall mites are summarized. *Aceria parapopulis* occurred in the southern portion of the boreal forest. No fully effective control for this pest was recognized at the time of this study. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-damage agents, aspen, balsam poplar, pest control

- Carder, A.C. 1972.** Climatic trends in the Beaverlodge area. Can. J. Plant Sci. 42:698-706.

An analysis of weather records from Beaverlodge from 1916 to 1960 suggests that spring and fall seasons have become warmer. This warming trend has resulted in a longer frost-free period. The annual precipitation rate increased 4.6 cm during the 45-year study period. (Location: 83 M)

Key words: Climate and related effects

- Case, J.W. 1977.** Lichens on *Populus tremuloides* in western central Alberta, Canada. Bryologist 80:48-70.

This study found 74 lichens on aspen in west-central Alberta. The geographical and vertical distribution and aspect preferences of each lichen species are described. The aspen epiphytic lichen flora of this region closely resembles that of Prince Albert National Park, Saskatchewan. (Location: 83 E, F, G, J-O; 84 B, C, D)

Key words: Vegetation assessment, ecology, aspen

- Case, J.W. 1978.** Epiphytic lichens as biological monitors of air pollution in west central

Alberta. Ph.D. thesis, Univ. Calgary, Calgary, Alberta.

Lichens were used as early indicators of sulfur dioxide emission effects. It was found that sulfur content in these plants was related to distance from the source, but was also influenced by wind patterns. This thesis also provides some information on plant community-types and composition within the study area. (Location: 83 F, G, J, K)

Key words: Vegetation assessment, pollution effects, vegetation classification

- Cayford, J.H. 1957.** Influence of the aspen overstory on white spruce growth in Saskatchewan. Can. Dep. North. Aff. Nat. Resour., For. Branch, For. Res. Div. Tech. Note 58.

The author suggests that white spruce up to 100 years old were suppressed by aspen, which can reduce tree volumes by 50%. It is suggested that aspen be removed before stands reach 40-50 years of age. (Location: 73 H)

Key words: Even-aged stand management, aspen, white spruce, juvenile stand-tending

- Cayford, J.H.; Hildahl, V.; Nairn, L.D.; Wheaton, M.P.H. 1959.** Injury to trees from winter drying and frost in Manitoba and Saskatchewan in 1958. For. Chron. 35:282-290.

The authors describe injury to trees resulting from the unusual weather conditions during the winter and spring of 1958. The aspen trees experienced high bud mortality, and development of foliage was late, in scattered clusters, and with abnormally large leaves. Stem analyses showed that the radial increment of aspen was reduced by 95%. (Location: 62 K; 52 E)

Key words: Climate and related effects, aspen, growth and yield, forest-damage agents

- C.D. Schultz and Company Ltd. 1973.** The environmental effects of timber harvesting in the Edson and Grande Prairie forests of Alberta. Project report for the Minister of Land and Forests, Government of Alberta, Edmonton, Canada. C.D. Schultz, Vancouver, British Columbia.

An overview is given of the natural resources in the Grande Prairie, Edson, and

Whitecourt forests. A summary of the provincial forest-management system and forestry operations is also presented. The analysis is primarily oriented toward conifers. (Location: 83 F, K)

Key words: Forest-harvesting effects, economics—fiber, economics—nonfiber, hydrology, birds, small mammals, furbearers, ungulates

Cerezke, H.F. 1991a. Fall and spring cankerworm. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 12.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agents; and prevention and control of fall and spring cankerworm. (Location: Canada)

Key words: Forest-damage agents, pest control

Cerezke, H.F. 1991b. Forest tent caterpillar. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 10.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of forest tent caterpillar. (Location: Canada)

Key words: Forest-damage agents, balsam poplar, white birch, pest control

Cerezke, H.F. 1991c. Spruce budworm. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 9.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of spruce budworm. (Location: Canada)

Key words: Forest-damage agents, white spruce, balsam fir, pest control

Cerezke, H.F. 1992. Large aspen tortrix. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 21.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of large aspen tortrix. (Location: Canada)

Key words: Forest-damage agents, aspen, balsam poplar, white birch, pest control

Cerezke, H.F. 1994a. Bronze birch borer. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 26.

This leaflet summarizes factors such as distribution and hosts; symptoms, signs, and damage; causal agent; and prevention and control of bronze birch borers. (Location: Canada)

Key words: Forest-damage agents, white birch, pest control

Cerezke, H.F. 1994b. Warren root collar weevil, *Hylobius warreni* Wood (Coleoptera: Curculionidae), in Canada: ecology, behavior, damage relationships, and management. Can. Entomol. 126:1383-1442.

The life history, population dynamics, and ecological requirements of the Warren root collar weevil are summarized. Population estimates suggested that this weevil occurred in most studied stands at low levels. Guidelines are offered for controlling this forest-damage agent. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-damage agents, white spruce, lodgepole pine, jack pine

Cesana, A.J.; Waddington, J.; Bittman, S. 1989. Residues of 2,4-D and Picloram in aspen poplar and soil after application with a roller. Can. J. Plant Sci. 69:205-212.

Between 11 and 16% of the Picloram applied to the trees in this study reached the soil. The residues were not considered to be an environmental problem because of the product's slow release from poplar tissue by leaching and decay. (Location: 72 J)

Key words: Vegetation control—chemical, soil and site conditions, aspen

Cheliak, W.M. 1980. Genetic variation of trembling aspen in Alberta. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

The leaf morphology of aspen was investigated. Eight morphological and two ratio characteristics had significant within-population variances. Discriminant analysis showed population groupings could be defined by latitude. Leaf-blade length was found to be the best

character for discriminating among populations. (Location: Alberta)

Key words: Genetics and cellular structure, ecology, aspen

Cheliak, W.M.; Dancik, B.P. 1982. Genetic diversity of natural populations of a clone-forming tree *Populus tremuloides*. Can. J. Genet. Cytol. 24:611-616.

This study electrophoretically investigated the effects of asexual reproduction on population structure and genetic variation in trembling aspen. Levels of genetic diversity were found to be greater than those reported for comparable sexually reproducing plants and animals. (Location: Alberta)

Key words: Genetics and cellular structure, aspen, ecology

Chesterman, D.; Stelfox, J.B. 1995. Relationships between microclimate and stand age and structure in aspen mixedwood forests in Alberta. Pages 13-27 in J.B. Stelfox, ed. Relationships between stand age, stand structure, and biodiversity in aspen mixedwood forests in Alberta. Alta. Environ. Cent., Vegreville, Alberta, Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Alta. Land For. Serv., Edmonton, Alberta.

The climate in 12 aspen stands ranging in age from 23 to 146 years was measured for 17 months. Included in the measurements were precipitation, air temperatures (at 25 and 125 cm), soil temperatures (at -5 and -25 cm), wind speed, and photosynthetically active radiation. A comparison of measured conditions and stand ages suggests that greater ranges of summer temperatures occurred in younger than older stands, and aboveground temperatures were positively related to herb cover and negatively related to shrub cover. (Location: 73 L; 83 P)

Key words: Climate and related effects, ecology, vegetation assessment, aspen

Chrosiewicz, Z. 1988. Forest regeneration on burned, planted, and seeded clear-cuts in central Saskatchewan. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-293.

The effectiveness of seeding and planting of white spruce after 8 years of growth was tested in burned clear-cuts. It was found that spring planting of jack pine was better than either seeding or fall planting. White spruce success was poor, but aspen establishment was generally good on all of the tested treatments, both in terms of frequency and height growth. (Location: 73 H)

Key words: Reforestation, site preparation, fire management and effects, white spruce, jack pine, aspen

Cieszewski, C.J.; Bella, I.E. 1991. Polymorphic height and site index curves for the major tree species in Alberta. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Manage. Note 51.

Using the VASI (variable-age-site index) model, this paper presents height-growth curves for four tree species, including aspen. Data were derived from Alberta Forest Service, Weldwood of Canada Limited, and Forestry Canada data sets. (Location: Alberta)

Key words: Growth and yield, aspen, lodgepole pine, black spruce, white spruce

Constabel, A.J. 1995. Light transmission through boreal mixedwood stands. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

Constabel, A.J.; Lieffers, V.J. 1996. Seasonal patterns of light transmission through boreal mixedwood canopies. Can. J. For. Res. 26:1008-1014.

Intercept of photoactive radiation by forest overstory and understory plants reduced the amount received at the forest floor to about 6% of the incident light. The greatest amount of photoactive radiation reached the forest floor in spring prior to leafing. Measurements suggested that the typical amount of light reaching the forest floor during summer was only slightly above the photosynthetic light compensation point of white spruce. *Also see* Constabel (1995). (Location: 83 J)

Key words: Climate and related effects, reforestation, ecology

Cordes, L.D.; Hartwell, S.L.; Strong, W.L. 1975. Environmental assessment of the Pine Lake area, Wood Buffalo National Park. Can. Dep. Indian Aff. North. Dev., Natl. Hist. Parks Branch, Winnipeg, Manitoba.

An environmental analysis was conducted in a 29-km² recreation area of Wood Buffalo National Park. Surficial deposits, soils, topography, and vegetation were mapped at a scale of 1:6000. Fifteen forest and wetland communities were recognized and sampled. In addition, trampling experiments were conducted to determine the sensitivity of the ground vegetation. (Location: 84 P)

Key words: Vegetation classification, soil survey, vegetation assessment, physical land classification and geology

Cormack, R.G.H. 1965. The effect of calcium ions and pH on the development of callus tissue on stem cuttings of balsam poplar. Can. J. Bot. 43:75-83.

This paper compares the callus tissue produced on stem cuttings of balsam poplar grown in distilled water and in saturated solutions of CaSO₄ from 6.0 to 11.0 pH. Differences in callus morphology, hardness, and cellular structure were observed. The emergence and subsequent growth of adventitious roots decreased with increased alkalinity. (Location: Not applicable; laboratory study)

Key words: Genetics and cellular structure, balsam poplar, plant propagation

Cormack, R.G.H.; Lemay, P.L. 1966. A further study of callus tissue development on stem cuttings of balsam poplar. Can. J. Bot. 44:47-50.

When balsam poplar cuttings are grown in a saturated solution of CaSO₄ (pH 11) for 10 days and then transferred to distilled water for another 10 days, the resulting callus mass shows two distinctive types of tissue. Reversal of the process results in a reversal of the location of the two tissue types. (Location: Not applicable; laboratory study)

Key words: Genetics and cellular structure, balsam poplar, plant propagation

Corns, I.G.W. 1972. Early plant succession after clearcutting of lodgepole pine in the Lower

Foothills of Alberta. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

The composition of clear-cut and scarified blocks was compared with the compositions of adjacent native lodgepole pine and mixed pine and aspen stands. The study finds that tree densities stabilized within 6 years after cutting, and clear-cut stands were richer in vascular species and had a more even distribution of cover among species than mature stands. Aspen and lodgepole pine biomass was estimated on 6- and 12-year-old clear-cuts. Also see Corns and La Roi (1976). (Location: 83 F)

Key words: Forest-harvesting effects, vegetation assessment, ecology, tree-crop production, aspen, lodgepole pine

Corns, I.G.W. 1978. Tree growth prediction and plant community distribution in relation to environmental factors in lodgepole pine, white spruce, black spruce, and aspen forests of western Alberta foothills. Ph.D. thesis, Univ. Alta., Edmonton, Alberta.

The objective of this research project was to determine the relationships among forest growth, plant community distribution, and environmental factors within the boreal and subalpine forests of the Wapiti map area. One of the 15 recognized vegetation types was dominated by aspen. Multiple-regression equations were developed for growth-environmental factors. The predictive capability of the equations was significantly increased when vegetation variables were added to the equations. (Location: 83 L)

Key words: Soil and site conditions, soil and site productivity, vegetation classification, tree-crop production, ecology

Corns, I.G.W. 1983. Forest community types of west-central Alberta in relation to selected environmental factors. Can. J. For. Res. 13:995-1010.

Sixteen forest-plant communities are described in terms of their composition and associated site conditions. Information is presented on successional relationships and forest productivity. The data used in this paper were primarily derived from Corns (1978). (Location: 83 L)

Key words: Vegetation classification, soil and site conditions, tree-crop production, ecology

- Corns, I.G.W. 1988. Site classification and productivity in the boreal mixedwood. Pages 61–69 in J.K. Samoil, ed. *Management and utilization of northern mixedwoods*. Proc. Symp., April 11–14, 1988, Edmonton, Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-296.

This paper focuses on the basic principles of forest-site classification and its potential use in forest management. The author discusses some representative site types in boreal mixedwood forests, and outlines problems and opportunities with respect to the use of site-classification information. (Location: Not applicable; literature review)

Key words: Ecological land classification, soil and site productivity, tree-crop production

- Corns, I.G.W. 1989. Ecosystems with potential for aspen management. *For. Chron.* 65:16–22.

Various approaches to site classification with respect to aspen ecosystems in Canada are reviewed. The author advocates the continued development of more comprehensive management interpretations and identifies the need for basic research to develop management systems more fully for aspen. (Location: Canada)

Key words: Ecological land classification, aspen, soil and site conditions, soil and site productivity, land evaluation

- Corns, I.G.W.; Annas, R.M. 1986. Field guide to forest ecosystems of west-central Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta.

This field guide describes 30 plant community associations including typical site conditions and productivity data, and provides management interpretations. This manual was superseded by Beckingham, Corns, and Archibald (1996). (Location: 83 E, F, K, L)

Key words: Vegetation classification, soil and site conditions, site preparation, tree-crop production, land evaluation

- Corns, I.G.W.; La Roi, G.H. 1976. A comparison of mature with recently clear-cut and scarified lodgepole pine forest in the Lower Foothills of Alberta. *Can. J. For. Res.* 6:20–32.

The composition of clear-cut and scarified blocks are compared with adjacent native lodgepole pine and mixed pine and aspen stands. The study found that tree densities stabilized within 6 years after cutting, and clear-cut stands were richer in vascular species and had a more even distribution of cover among species than mature stands. (Location: 83 F)

Key words: Forest-harvesting effects, vegetation assessment, site preparation, lodgepole pine, aspen

- Corns, W.G.; Dai, T.-S. 1967. Effects of added surfactant on toxicity of picloram, 2,4-D and 2,4,5-T to *Populus tremuloides* Michx. and *Populus balsamifera* L. saplings. *Can. J. Plant Sci.* 47:711–712.

This study determined the efficacy of various herbicides to control poplar species. The results indicated that a picloram-2,4-D mixture was enhanced by the addition of surfactant, but was not as effective as the picloram alone on aspen in most cases. (Location: Not specified)

Key words: Vegetation control—chemical, aspen, balsam poplar

- Cotterill, S.C. 1996. Effects of clearcutting on artificial egg predation in boreal mixedwood forests in north-central Alberta. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

This study found predation on avifauna eggs to be greater for ground than shrub nesters, with large year-to-year variation. Red-backed voles, red squirrels, and birds were among the observed predators, with red squirrels and gray jays being the primary predators. No significant differences in predation rates were detected due to clear-cutting or related to the increased amount in forest edge. (Location: 83 P)

Key words: Forest-harvesting effects, birds, small mammals, wildlife distribution and diversity

- Crampton, C.B. 1973. Studies of vegetation, land-form, and permafrost in the Mackenzie Valley:

landscape survey in the upper and central Mackenzie Valley. North. Pipelines, Task Force North. Oil Dev., Environ. Social Comm. Rep. 73-8.

This is a landscape survey (1:250 000) of the upper and central Mackenzie Valley (44 800 km²). Maps of vegetation, landforms, and permafrost in the area are provided, and landscape units are rated according to sensitivity to vehicular disturbance. (Location: Western Northwest Territories)

Key words: Ecological land classification, land evaluation

Crampton, L.H. 1995. Habitat selection by bats and potential impacts of forest fragmentation on bat populations in aspen mixedwood forests in northern Alberta. M.Sc. thesis, Univ. Calgary, Calgary, Alberta.

This study assesses bat populations and habitat preferences in mixedwood stands to evaluate the potential impact that forest harvesting might have on roosting and foraging grounds. In aspen stands, bats were most abundant in old stands. (Location: 73 L; 83 P)

Key words: Small mammals, wildlife habitat assessment, wildlife distribution and diversity, environmental impacts

Crampton, L.H.; Barclay, R.M.R. 1995. Relationship between bats and stand age and structure in aspen mixedwood forests in Alberta. Pages 211-225 in J.B. Stelfox, ed. Relationships between stand age, stand structure, and biodiversity in aspen mixedwood forests in Alberta. Alta. Environ. Cent., Vegreville, Alberta, Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Land For. Serv., Edmonton, Alberta.

Twelve aspen stands ranging from 23 to 146 years old and representing three age classes were surveyed for bats. Five species were detected, with little brown and silver-haired bats being the most abundant. This abundance was greatest in older aspen stands. The authors postulate that the bats occurred in older stands due to the occurrence of appropriate foraging and roosting habitats, and a more open structure

that allows easier foraging. (Location: 73 L; 83 P)

Key words: Wildlife distribution and diversity, small mammals, aspen

Crites, S.; Dale, M. 1995. Relationships between nonvascular species and stand age and stand structure in aspen mixedwood forests in Alberta. Pages 91-114 in J.B. Stelfox, ed. Relationships between stand age, stand structure, and biodiversity in aspen mixedwood forests in Alberta. Alta. Environ. Cent., Vegreville, Alberta, Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Land For. Serv., Edmonton, Alberta.

The abundance of nonvascular species was evaluated in three age classes of aspen. These age classes were composed of 12 stands ranged from 23 to 146 years old. Stands in the older age class had a greater diversity of nonvascular species due to a greater variation in woody substrates for colonization (i.e., different stages of decomposition and size classes). Older stands also had greater rates of coarse woody debris input than younger stands. (Location: 73 L; 83 P)

Key words: Vegetation assessment, ecology, aspen, unique resources

Crosson, L.S.; Ellis, J.G.; Shields, J.A. 1970. The soils of the northern provincial forest reserves in the Shellbrook map sheet (73G), Saskatchewan. Univ. Sask., Ext. Div., Sask. Inst. Pedol., Saskatoon, Saskatchewan. Publ. SF.1.

A soils inventory was conducted in an area located northwest of Prince Albert (284 400 km²) and a 1:126 720-scale map was prepared. Forest and agriculture capability ratings were developed for each soil association. Area estimates are provided for agriculture capability and soil associations. Physical and chemical data are also provided for selected soil associations. (Location: 73 G)

Key words: Soil survey, soil and site conditions, land evaluation

Cumming, S.G.; Burton, P.J.; Joy, M.; Klinkenberg, B.; Schmiegelow, F.K.A.; Smith, J.N.M. 1995. Experimental habitat fragmentation and

simulation of landscape dynamics in the boreal mixedwood: a pilot study. *Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Land For. Serv., Edmonton, Alberta. Can.-Alta. Partnership Agreement For. Rep.* 137.

The biophysical resources of a 74 000-km² area were reviewed with a primary focus on forest composition and fire history. The resulting data base will be used to model boreal mixedwood forest dynamics. The modeling and associated analyses will be used to compare the effects of natural fires with large-scale forest harvesting in the area. As part of this work, field experimental sites were established west of Calling Lake, with birds selected as the indicator group. (Location: 73 M, P; 74 A, D, E, H; 84 B, G, O)

Key words: Vegetation assessment, fire ecology, forest-harvesting effects, birds, wildlife-habitat assessment

D.A. Westworth and Associates Ltd. 1981. A study of the impact on wildlife of short-rotation management of boreal aspen stands—interim report. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. ENFOR P-164.

This project assessed the potential effects of short-rotation harvesting of aspen on wildlife. Although this is a preliminary report, the results show that snags were important to certain bird species, particular in young stands of fire origin. It was noted that remnant snags would not occur if forest stands were subjected to short rotational management. (Location: 83 B)

Key words: Wildlife-habitat assessment, forest-harvesting effects, aspen, birds

D.A. Westworth and Associates Ltd. 1990. Significant natural features of the eastern boreal forest region of Alberta. Alta. For. Land Wildl., Edmonton, Alberta.

The purpose of this study was to identify significant natural features in an area that occurred primarily within the Athabasca River drainage basin. Of the 234 significant features identified, three sites were classified as nationally significant, 44 as provincially significant,

and 187 as regionally significant. (Location: Eastern Alberta)

Key words: Unique resources, significant natural features

Dai, T.-S. 1966. Comparative effects of certain herbicides on aspen and balsam poplar. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

This paper finds that Tordon 22K was the most toxic to aspen and balsam poplar cuttings, foliage, and roots of the herbicides tested. Ester formulations of 2,4-D and 2,4,5-T were found to be more effective than other formulations of 2,4-D for killing foliage. (Location: Not applicable; laboratory study)

Key words: Vegetation control—chemical, aspen, balsam poplar

Dancik, B.P.; Brace, L.; Stelfox, J.; Udell, B. 1990. Forest management in Alberta: report of the Expert Review Panel. Alta. For. Lands Wildl., Edmonton, Alberta. Publ. I/340.

This paper reports that an expert panel reviewed public concerns over the disposition of forest lands to new forest industries in Alberta. Public concerns included topics related to regulatory agencies, the planning process, technical aspects of management, environmental impacts of harvesting, integrated forest management, and reforestation. Concern was expressed over declining forest research. (Location: Alberta)

Key words: Forest-harvesting effects, reforestation, forest policy, resource planning

De Franceschi, J. 1969. A co-operative pulping study of young aspen; data collection and summaries. Can. Dep. Fish. For., Can. For. Serv., For. Res. Lab., Winnipeg, Manitoba. Intern. Rep. MS-103.

The proportion of wood, leaves, and branch biomass was determined for young aspen stands (7, 13, 22 years old). Data indicated that the proportion of leaves and twigs decreased with increasing age relative to the bole. (Location: 62 K)

Key words: Growth and yield, aspen

De Franceschi, J.P.; Bell, F.W. 1990. Labor productivity and costs of motor-manual release of

spruce from hardwoods in Manitoba. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-312.

The cost to cut aspen as a release technique was assessed. Two techniques were compared: brush-sawing and chain-sawing. Total costs in a young (25-year-old) stand were \$690/ha and \$428/ha for each system, respectively. In an older stand (55-year-old), it cost \$350/ha. (Location: 62 N)

Key words: Uneven-aged stand management, juvenile stand-tending, vegetation control—mechanical, aspen, white spruce

Delisle, G.P.; Hall, R.J. 1987. Forest fire history maps of Alberta, 1931 to 1983. Can. For. Serv., North. For. Cent., Edmonton, Alberta.

The location and size (200 ha) of wild fires that occurred in Alberta after 1930 were plotted on a series of 1:500 000-scale maps and accounted for 85% of the total area burned in Alberta. The mapping is generally based on six time periods (1931–40, 1941–43, 1944–49, 1949–66, 1967–80, 1981–83), although specific dates, size of burns, and cause are provided for specific sites. (Location: Alberta)

Key words: Fire ecology, fire management and effects

Delong, H.B. 1995. The effects of microsite on first year establishment of white spruce beneath aspen dominated boreal mixedwood forests. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

This study compared exposed mineral soil as small and large patches, mineral soil mounds, and logs as potential white spruce establishment sites beneath boreal aspen stands. It was found that mounds, large mineral soil patches, and decomposing logs tended to be the most favorable sites. Small patches and undisturbed forest floor litter were relatively poor sites. Reduced competition, higher June rooting-zone temperatures, and reduced resistances to rooting were associated with more favorable substrates. (Location: 83 J)

Key words: Site preparation, reforestation, silviculture, uneven-aged stand management, white spruce

Denney, N. 1988. Problems of mixedwood management. Pages 48–49 in J.K. Samoil, ed. Management and utilization of northern mixedwoods. Proc. Symp., April 11–14, 1988, Edmonton, Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-296.

Problems associated with the current tenure system in Alberta are identified. The author suggests that a dual-tenure system in the mixedwood (i.e., softwood and hardwood) and the orientation of regeneration toward conifers are significant management problems. (Location: Alberta)

Key words: Forest policy, resource planning

Digweed, S.C. 1995. Effects of natural enemies, competition, and host plant quality on introduced birch leafminers (Hymenoptera: Tenthredinidae). M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

The distribution and phenology of birch leaf miners, and factors such as competition from other related insects, were studied in native boreal mixedwood and aspen parkland forest stands. The purpose of this study is to aid in the control of urban birch leaf miners. Two species were common (*Fenusa pusilla* and *Profenusa thomsoni*) that were both introduced and found throughout Alberta. (Location: Alberta)

Key words: Invertebrates, pest control, forest-damage agents, white birch

Dix, R.L.; Swan, J.M.A. 1971. The roles of disturbance and succession in upland forest at Candle Lake, Saskatchewan. Can. J. Bot. 49:657–676.

This study attempts to determine the relative importance of disturbance and forest succession in landscape pattern, and to relate succession to site conditions. Conclusions are drawn regarding the species most likely to dominate different sites following severe fire, and the kinds of vegetational changes likely to occur on them between disturbances. (Location: 73 H)

Key words: Ecology, soil and site conditions, vegetation classification, fire ecology

Doerr, P.D.; Keith, L.B.; Rusch, D.H.; Fisher, C.A. 1974. Characteristics of winter feeding

aggregations of ruffed grouse in Alberta. J. Wildl. Manage. 38:601-615.

This study assesses grouse winter-feeding habitats as they relate to the consumption of tree buds. It was found that grouse primarily fed immediately before sunrise and just after sunset, mostly on aspen and willow buds or twigs. (Location: 83 I)

Key words: Wildlife-habitat assessment, vegetation assessment, birds, aspen

Donald, R.G.; Anderson, A.W.; Stewart, J.W.B. 1993. The distribution of selected soil properties in relation to landscape morphology in forested gray luvisol soils. Can. J. Soil Sci. 73:165-172.

This study is an intensive microscale assessment of soil property-topography relationships. Factors such as horizon thickness, pH, depth to carbonates, and clay content are analyzed. (Location: 73 G)

Key words: Soil and site conditions

Doucet, R. 1989. Regeneration silviculture of aspen. For. Chron. 65:23-27.

Factors that affect aspen regeneration are reviewed. Among the factors considered are seed and vegetation reproduction, stand development, and conversion. The author concludes that conversion of poor sites from aspen to other species is possible, but considerably more difficult than on good sites. (Location: Not applicable; literature review)

Key words: Aspen, reforestation, silviculture

Downing, D.J.; Bennett, K.J. 1984. Ecological land classification of the Bear River-Wapiti area: preliminary report. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta.

An ecological land classification (1:15 000) was developed for an area (105 km²) located southeast of Grande Prairie. A description of the soil, terrain, and vegetation resources is presented for each ecosite. Several cross-sectional diagrams illustrate the relationship between site conditions and vegetation. (Location: 83 M)

Key words: Ecological land classification, vegetation assessment, soil and site conditions

Downing, D.; Karpuk, E. 1992. Aspen vegetation types of the low boreal mixedwood ecoregion, east-central Alberta, first approximation. Alta. For. Lands Wildl., Land Inf. Serv. Div., Edmonton, Alberta. Publ. T/271.

A classification of aspen forest vegetation in the Low Boreal Mixedwood Ecoregion was developed to assess forest grazing potential. Six plant community-types are recognized, and compositional data are provided as well as the associated site conditions. (Location: 73 E, L; 83 H, I)

Key words: Vegetation classification, forest grazing, soil and site conditions

Downing, D.; O'Leary, D.; Schultz, R. 1986. Integrated resource inventory of the Smoky-Peace Point study area. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/121-1.

An integrated-resource inventory (1:100 000) was prepared for the Smoky-Peace Point study area (650 km²). Volume I of this report presents land classifications, a summary of ecosections and vegetation types, and evaluations for agriculture and wildlife for the area. Volume II describes the vegetation types and site productivity. (Location: 84 C, N)

Key words: Ecological land classification, vegetation classification, land evaluation

Downing, D.; O'Leary, D.; Schultz, R. 1987. Integrated resource inventory of the East Peace study area. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Publ. T/154.

An ecological land classification (1:100 000) was developed for a 14 200-km² area located north of Peace River townsite. Land-capability assessments are made for a variety of wildlife species, forestry, and agriculture. Volume II contains a tabular summary of polygon attributes and land-evaluation ratings. (Location: 84 C, F)

Key words: Ecological land classification, land evaluation

Downing, D.J.; Legris, A. 1988. Whitemud Falls ecological reserve biophysical inventory. Alta. For. Lands Wildl., Land Inf. Serv. Div., Edmonton, Alberta. Publ. T/174.

A biophysical inventory was conducted in the Whitemud Ecological Reserve (900 ha). Vegetation, soils, site conditions, and surficial materials were examined and organized into an ecological land classification (1:15 000 scale). Wildlife resources are also summarized. Three aspen and/or balsam poplar community-types are recognized and the report contains the associated relevé information. (Location: 74 D)

Key words: Ecological land classification, unique resources, soil and site conditions, wildlife distribution and diversity, vegetation classification

Drouin, J.A. 1989. Herbicide efficacy trials in Alberta and Manitoba, 1980-1985. For. Can., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-306.

From vegetation control trials in various locations, data were obtained on conifer growth and release following the application of various herbicides. Data were also collected on the ability of the herbicide to control competing vegetation. (Location: 52 E, L; 83 F, L, O, P)

Key words: Vegetation control—chemical

Drouin, J.A.; Emond, F.J.; Cerezke, H.F. 1991. Pear sawfly. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet 13.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agents; and prevention and control of pear sawfly. (Location: Canada)

Key words: Forest-damage agents, pest control

Drouin, J.A.; Kusch, D.S. 1975. Pesticide field trials on shade and shelterbelt trees in Alberta and Saskatchewan, 1974. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-131.

The purpose of these trials was to obtain information on the chemical efficacy of 22 insecticides and two fungicides. Among the forest insect pests and fungi that occurred in the trials were forest tent caterpillar, poplar borer, blotch leaf miner, and poplar leaf spot. (Location: Saskatchewan)

Key words: Forest-damage agents, pest control

Drouin, J.A.; Kusch, D.S. 1976. Pesticide field trials on shade and shelterbelt trees in Alberta, 1975. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-150.

For this study, the authors tested 37 chemicals to determine their ability to control 14 organisms. The results indicate that 17 chemicals were suitable for controlling eight insects. The results are summarized by pest, with an identification of the host plant and test procedures. (Location: Alberta)

Key words: Forest-damage agents, pest control

Drouin, J.A.; Kusch, D.S. 1977. Pesticide field trials on shade and shelterbelt trees in Alberta, 1976. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-184.

This study tested the efficiency of 28 insecticides, two microbials, and an adjuvant. Two of the 10 target organisms were the forest tent caterpillar and the mold mite, which feed on aspen. The tested chemicals had an 80-100% success rate for controlling these two species. (Location: Central Alberta)

Key words: Forest-damage agents, aspen, pest control

Drouin, J.A.; Kusch, D.S. 1979. Pesticide field trials on shade and shelterbelt trees in Alberta, 1978. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-213.

The purpose of this study was to determine the efficacy of 22 insecticides, optimum timing of application, equipment performance, and adverse effects on host plants on 13 insect pests. Of these 13, three insects were hosts on commercial hardwoods: birch leaf mining sawflies, forest tent caterpillars, and large aspen tortrix. Overall, the insecticides were effective. (Location: Alberta)

Key words: Forest-damage agents, pest control

Drouin, J.A.; Kusch, D.S. 1980. Pesticide field trials on shade and shelterbelt trees in Alberta, 1979. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-227.

Nineteen insecticides were tested for their ability to control 15 insects. The study found 14 of these chemicals controlled nine species. The results are summarized by pest, with an identification of the host plant and test procedures. (Location: Alberta)

Key words: Forest-damage agents, pest control

Drouin, J.A.; Langor, D.W. 1991. White pine weevil. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 8.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of white pine weevil. (Location: Canada)

Key words: Forest-damage agents, pest control

Drouin, J.A.; Langor, D.W. 1992. Poplar bud gall mite. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 15.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of poplar bud gall mite. (Location: Canada)

Key words: Forest-damage agents, aspen, pest control

Drouin, J.A.; Wong, H.R. 1975. Biology, damage, and chemical control of the poplar borer (*Saperda calcarata*) in the junction of the root and stem of balsam poplar in western Canada. Can. J. For. Res. 5:433-439.

This study describes the biology, damage, and the chemical control of poplar borer on regenerating balsam poplar growing on poor or disturbed sites in western Canada. Of the 10 tested systemic insecticides, best results were obtained with dimethoate applied as a soil drench. (Location: 73 B; 83 G)

Key words: Forest-damage agents, balsam poplar, pest control

Duffy, P.J.B. 1963. Plantations of white spruce under aspen on different soils, Foothills section, Alberta. Can. Dep. For., For. Res. Branch, Calgary, Alberta. Establish. Rep. A-83.

This report describes the efforts undertaken to establish white spruce seedling plantations

beneath overmature aspen and balsam poplar stands. Also see Duffy and Nemeth (1965). (Location: 83 O)

Key words: Uneven-aged stand management, reforestation, aspen, white spruce, soil and site conditions

Duffy, P.J.B. 1965. A forest land classification for the mixedwood section of Alberta. Can. Dep. For., For. Res. Branch, Ottawa, Ontario. Publ. 1128.

This study provides a description and classification of soils and forest productivity in the Mixedwood forest area. The results focus primarily on site index for white spruce in relation to soil-moisture status and parent materials. (Location: 83 O, P)

Key words: Ecological land classification, soil and site productivity, soil and site conditions, growth and yield

Duffy, P.J.B.; Nemeth, Z. 1965. Plantations of white spruce under aspen on different soils, Foothills section, Alberta: the Rocky Mountain House plantations—establishment report, 1965. Can. Dep. For. Rural Dev., For. Res. Lab., Calgary, Alberta. Intern. Rep. A-1.

The locations (maps and photos) and designs of experimental plots in the Smith and Lawrence lakes region were described. White spruce were differentially planted beneath aspen, while other sites were strip-scarified and planted to white spruce. (Location: 83 O, P)

Key words: Aspen, white spruce, uneven-aged stand management, soil and site conditions

Duffy, P.J.B.; Nemeth, Z. 1967. Plantations of white spruce under aspen on different soils, mixedwood section, Alberta: the Athabasca plantations—establishment report, 1966. Can. Dep. For. Rural Dev., For. Res. Lab., Calgary, Alberta. Intern. Rep. A-7.

This report describes efforts to establish white spruce plantations under overmature/mature aspen stands and on scarified strips. Blading was the chosen method of scarification. There are no conclusions or recommendations made; this is an ongoing study. (Location: 83 O, P)

Key words: White spruce, aspen, uneven-aged stand management, site preparation

Dumanski, J.; Macyk, T.M.; Veauvy, C.F.; Lindsay, J.D. 1972. Soil survey and land evaluation of the Hinton-Edson area, Alberta. Res. Counc. Alta., Alta. Inst. Pedol., Edmonton. Rep. S-72-31.

A reconnaissance soil survey (1:126 720) of the Hinton-Edson area was prepared for a 1458-km² area. The characteristics, distribution, and abundance of each soil series are described and assessed for forest capability. The parent material and processes leading to the development of various soil series are discussed. (Location: 83 F)

Key words: Soil survey, land evaluation, soil and site conditions

Dutchak, K.L. 1979. Ecological land classification and evaluation: Carcajou study area. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. 117.

This study organizes the natural resources in the study area (2243 km²) into an ecological land classification (1:100 000 scale). A description is provided of each ecosection as well as Canada Land Inventory-equivalent ratings for agriculture, forestry, recreation, ungulates, and waterfowl capability. In general, the area was dominated by deciduous forest intermixed with wetlands. (Location: 84 F)

Key words: Ecological land classification, land evaluation

Dutchak, K.L. 1982. Ecological land classification and evaluation: Brazeau-Pembina study area. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. T/11-2.

A detailed ecological land classification (1:100 000) was prepared for the Brazeau-Pembina study area (2911 km²). The natural resources are summarized for each ecosection. The eastern portion of the study area occurred with the Lower Boreal-Cordilleran Ecoregion. (Location: 83 B, C, F, G)

Key words: Ecological land classification, land evaluation

Dutchak, K.L. 1984. Ecological land classification and evaluation: Rocky-North Saskatchewan. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. T/11-8.

An ecological land classification (1:100 000 scale) was prepared for a 6676-km² area along the eastern slopes of the Rocky Mountains between Rocky Mountain House and the Brazeau Reservoir. About three-quarters of the area occurs within the B.19a forest section (Rowe 1972). The soil, vegetation, and topographic characteristics are described for each ecosection. (Location: 83 B, C, G)

Key words: Ecological land classification

Dyck, J.R. 1994. Converting aspen stands to white spruce-aspen mixedwoods by planting and seeding. Manitoba: Manitoba Forestry Demonstration Areas. Nat. Resour. Can., Can. For. Serv., Northwest Reg., Manit. Dist. Office, Winnipeg, Manitoba. Manit. Nat. Resour., For. Branch, Winnipeg, Manitoba. Can.-Manit. Partnership Agreement For. Rep.

This study evaluates planting and seeding of white spruce on bladed strips in aspen stands. The authors conclude that: blading is a potential alternative to using herbicides; seedlings planted near the edge of a scalp benefit from nutrients in the adjacent undisturbed area; herbicides improve seedling survival; and seedlings can be successfully used but require careful site selection. (Location: 52 M; 53 D; 62 N, O, P; 63 A, B, C)

Key words: Site preparation, vegetation control—chemical, white spruce, reforestation

Ealey, D. 1979. The distribution, foraging behaviour and allied activities of the white pelican in the area of the Athabasca Oils Sands. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 83.

This report describes the distribution and movements, nonbreeding activities, habitat characteristics, diet, and effects of disturbance on white pelicans. The author found that pelicans forage primarily in water less than 1 m deep and feed mostly on fish such as northern pike, lake whitefish, and brook stickleback. (Location: 84 H)

Key words: Birds, wildlife-habitat assessment, wildlife distribution and diversity

- Ealey, D.M. 1987. A bibliography of Alberta mammalogy. Alta. Cult., Hist. Resour. Div., Edmonton, Alberta. Prov. Mus. Alta. Nat. Hist. Occas. Paper 8.**

This bibliography includes 3791 citations on various mammal species. Among the topics included are status and distribution, ecology and life history, behavior, management and conservation, environmental impact, pesticides and pollution, and research and management techniques. (Location: Alberta)

Key words: Wildlife distribution and diversity, wildlife-habitat assessment, ungulates, small mammals, furbearers

- Eberhart, K.E. 1986. Distribution and composition of residual vegetation associated with large fires in Alberta. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.**

This study examines the distribution and composition of residual vegetation following large fires. Results indicate that the distribution of residual vegetation varies by fire size rather than preburn vegetation type, and the composition of the residual vegetation differs according to preburn vegetation types but not by fire-size class. See Eberhart and Woodard 1987. (Location: Alberta)

Key words: Fire ecology, vegetation assessment, wildlife-habitat assessment, ungulates

- Eberhart, K.E.; Woodard, P.M. 1987. Distribution of residual vegetation associated with large fires in Alberta. Can. J. For. Res. 17:1207-1212.**

This study describes the residual vegetation islands within 69 fires (2 to 17 770 ha) that burned in Alberta from 1970 to 1983. Distribution of the residual vegetation is compared among five fire-size classes. Results indicate decreased potential for natural reforestation and increased benefits to some wildlife habitats as fire size increases. (Location: Alberta)

Key words: Fire ecology, vegetation assessment, wildlife-habitat assessment

- Edgar, L.; Mikalchuk, G.; O'Leary, D.; Schultz, R. 1986. Ecological inventory and evaluation of the Haig Lake study area. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Publ. 97.**

A large-scale (1:15 000) ecological land classification was prepared for the area surrounding Haig Lake, which is located at the southwest corner of Buffalo Head Hills. The characteristics of each ecological unit are summarized. Assessments are made for various recreational and related land uses. (Location: 84 C)

Key words: Ecological land classification, land evaluation, soil and site conditions

- Ehrentraut, G.; Branter, K. 1990. Vegetation management by manual and mechanical means in Alberta boreal forests. For. Chron. 66:366-368.**

The report describes three successful non-chemical means of site preparation for conifer seedlings: double-disking, which controls grasses and deciduous species on moist sites; Marttiini plowing, which controls deciduous species on moist to wet sites; and ripper-plowing, which controls deciduous species on wet sites. (Location: Alberta)

Key words: Vegetation control—mechanical, soil and site conditions

- Elhert, G.; Downing, D.J. 1994. Managing aspen range lands in Alberta's boreal mixedwood ecoregion: northeast region benchmark program. Alta. Agric. Rural Dev., Public Lands Branch, Edmonton, Alberta. Range Manage. Note 17.**

This paper is a summary of an ongoing forest grazing management study that is attempting to determine the quantity and quality of range plants available in boreal aspen stands in east-central Alberta. (Location: 73 E, L; 83 H, I)

Key words: Forest grazing, vegetation assessment, aspen

- Ellis, J.G.; Clayton, H.S. 1970. The physiographic divisions of the northern provincial forest in Saskatchewan. Univ. Sask., Sask. Inst. Pedol., Saskatoon, Saskatchewan. Publ. SP3.**

This study includes both a 1:760 320-scale map and descriptive report on physiographic

units found in the northern portion of Saskatchewan. The dominant soils are also related to these units. Selected information is provided on climate conditions. (Location: Saskatchewan)

Key words: Physical land classification and geology, soil survey, land evaluation, climate and related effects

Ellis, R.A. 1986. Understory development in aspen-white spruce forests in northern Alberta. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

This study investigated the effects of shifting tree-canopy dominance from broadleaf deciduous to needle leaf evergreen on the understory structure and composition of aspen-white spruce mixedwood forests in northern Alberta. Canopy cover and the development of a moss carpet were the two factors found to be most important in influencing understory structure and composition. Species richness, species diversity, and total vascular plant cover decreased with increasing evergreen canopy cover. (Location: Northeast Alberta)

Key words: Ecology, vegetation assessment

Erskine, A.J. 1977. Birds in boreal Canada: communities, densities, and adaptations. Fish. Environ. Can., Ottawa, Ontario. Can. Wildl. Serv. Rep. Ser. 41.

This monograph provides a broad overview of habitats used by birds. A portion of the report includes a section on birds found in deciduous and mixedwood stands. Several tables provide a comparison of bird densities by forest cover type. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Birds, wildlife-habitat assessment, wildlife distribution and diversity

Eulert, G.K.; Hernandez, J. 1980. Synecology and autecology of boreal forest vegetation in the Alberta Oil Sands Environmental Research Program study area. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 99.

A general overview of the ecology and vegetation of the Alberta Oil Sands Environmental Research Program area is presented. It also includes autecological reviews of selected tree and understory species such as alders, pin

cherry, saskatoon, bearberry, bog cranberry, and wintergreens. Distributional maps are provided for some species. (Location: 74 D, E)

Key words: Aspen, jack pine, balsam poplar, white birch, white spruce, black spruce, balsam fir, ecology, fire ecology

Feng, J.C.; Feng, C.C.; Sidhu, S.S. 1989. Determination of hexazinone residue and its release from a granular formulation under forest conditions. Can. J. For. Res. 19:378-381.

This study evaluates the percent release of hexazinone based on rainfall and length of exposure. This analysis was performed on a 3-year-old aspen cut-over south of Grande Prairie. Tables are provided for determining the period of exposure needed to achieve different levels of release after 0.25 to 25 mm of rainfall. (Location: 83 L)

Key words: Vegetation control—chemical, aspen, climate and related effects

Feng, J.C.; Navratil, S. 1990. Sampling for zero-time hexazinone residues in forest soil dissipation study. Can. J. For. Res. 20:1549-1552.

A method for measuring and monitoring herbicide residues is tested in the Calling Lake area. The proposed technique involves placing soil-filled jars in the forest floor. Soil-filled jars are compared to core samples. (Location: 84 P)

Key words: Vegetation control—chemical, pollution effects

Fenton, M.M.; Andriashek, L.D. 1983. Quaternary stratigraphy and surficial geology of the Sand River area, NST 73L. Alta. Res. Council, Terrain Sci. Dep., Edmonton, Alberta. Bull. 57.

A 1:250 000-scale map of surficial deposits in the Cold Lake and area to the west is presented and the composition, stratigraphy, and origin of the recognized and mapped deposits are described. A summary of preglacial and glacial history is also provided. (Location: 73 L)

Key words: Physical land classification and geology

Ferguson, N.B. 1980a. Physical land classification of the Berland current regional plan study area (1:250,000). Alta. Energy Nat. Resour.,

Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. 148.

A physical land classification was developed for a 9200-km² area in the west-central portion of Alberta. The area was divided into physiographic regions and subregions (1:250 000), and a description of the physical and terrain conditions is described for each map unit. A portion of the study area included deciduous and mixedwood boreal forests. (Location: 83 E, F, K, L)

Key words: Physical land classification and geology, soil and site conditions

Ferguson, N.B. 1980b. Physical land classification of the Willmore-Kakwa regional recreation plan study area. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/12-5.

A physical land classification was developed for a 10 200-km² study area in the Willmore Wilderness and Kakwa region (1:25 000). The area was divided into physiographic regions and subregions, and the physical and terrain conditions are described for each map unit. A portion of this study area included deciduous and mixedwood forests. (Location: 83 E, F, L)

Key words: Physical land classification and geology, soil and site conditions

Ferguson, T.A. 1980. Productivity and predictability of resource yield: Aboriginal controlled burning in the boreal forest. M.A. thesis, Univ. Alta., Edmonton, Alberta.

The author found that native peoples used fire to maintain grasslands and a high edge ratio between forest and other vegetation as an intentional technique to facilitate hunting in the boreal forest. They may have also used fire to maintain berry crops. Fires were most commonly set in spring and fall. (Location: 84 K, L, M, N)

Key words: Fire management and effects

Filion, F.L.; James, S.W.; Ducharme, J.L.; Pepper, W.; Reid, R.; Boxall, P.; Teillet, D. 1983. The importance of wildlife to Canadians: highlights of the 1981 national survey. Environ. Can., Can. Wildl. Serv., Ottawa, Ontario.

The socioeconomic benefits of wildlife are summarized for both consumptive (e.g., hunting) and nonconsumptive (e.g., wildlife viewing) uses. The analysis includes expenditures within provinces by activity and population characteristics. This report was updated in 1987. (Location: Canada)

Key words: Economics—nonfiber, ungulates, birds, small mammals, recreation

Fisher, G.L. 1982. Resource road planning guidelines for the Green Area of Alberta. Alta. Energy Nat. Resour., Alta. For. Serv., Edmonton, Alberta. Tech. Rep. T/25.

The objective of this report was to recommend methods to minimize environmental impact due to road construction by the timber and petroleum industries. Guidelines are provided on the design of roads, rights-of-way, grades, stream crossings, and erosion control. (Location: Alberta)

Key words: Environmental impact, forest policy, resource planning

Flanagan, L.B. 1985. Some aspects of the population biology and physiological ecology of *Aralia nudicaulis* L. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

See Flanagan and Moser (1985).

Flanagan, L.B.; Moser, W. 1985. Patterns of ¹⁴C assimilate distribution in a clonal herb, *Aralia nudicaulis*. Can. J. Bot. 63:2111-2114.

The pattern of carbon¹⁴ assimilate was examined in *Aralia nudicaulis* to determine the extent of physiological integration among individual shoots in a clone. Results suggest that most of the carbon assimilated by an individual shoot remains within that shoot for at least 24 hours. There were increased amounts of carbohydrate translocated from an unshaded shoot to the root and rhizome of shaded shoots. (Location: 83 O)

Key words: Vegetation assessment, ecology

Flannigan, M.D.; Van Wagner, C.E. 1991. Climatic change and wildfire in Canada. Can. J. For. Res. 21:66-72.

This study interprets the potential impact of climatic warming on the seasonal severity ratings for forest fires. The authors conclude that the severity of forest fires would probably increase about 40% if the amount of atmospheric carbon dioxide were doubled. (Location: 63 E)

Key words: Climate and related effects, fire ecology

Fleming, R.A.; Volney, W.J.A. 1995. Effects of climate change on insect defoliator population processes in Canada's boreal forest: some plausible scenarios. *Water Air Soil Pollut.* 82:445-454.

Climatic variables related to the expansion of forest-defoliator populations and the potential implications of climatic warming are evaluated. This conceptual paper includes factors such as the phenology of species, increasing carbon dioxide levels, and the potential effects of extreme weather events. (Location: Canada)

Key words: Pest control, forest-damage agents, invertebrates, climate and related effects

Francis, J.; Lumbis, K. 1979. Habitat relationships and management of terrestrial birds in north-eastern Alberta. *Alta. Environ., Alta. Oil Sands Environ. Res. Program*, Edmonton, Alberta. AOSERP Rep. 78.

The relative value of various vegetation types in the Alberta Oil Sands Environmental Research Area are evaluated as bird habitat. Also included is an annotated checklist of all bird species known to occur in the area. The authors conclude that bird populations and diversity are similar to other boreal areas. (Location: 74 D, E)

Key words: Wildlife-habitat assessment, birds, wildlife distribution and diversity

Franklin, S.E.; Hall, R.J.; Ghitler, G.S. 1995. Satellite remote sensing of white spruce understory in deciduous and mixedwood stands. Pages 239-247 in J.M. Power, M. Strome, and T.C. Daniels, eds. *Decision support—2001. Proc. 17th Annu. Geog. Inf. Semin., Resour. Technol. '94 Symp.*, September 12-16, 1994, Toronto, Ontario. Am. Soc. Photogramm. Remote Sens., Bethesda, Maryland.

An unsupervised classification approach was employed with leaf-off and leaf-on Landsat Thematic Mapper data to determine its ability to detect conifer understory stands mapped to three levels (nil, light, heavy) under five overstory classes. Stands with nil understory were statistically separable from stands with heavy understory, but there was overlap between nil and light understory, and between light and heavy understory. Further work with image texture and crown closure is recommended to improve isolation of stand structure effects on Landsat Thematic Mapper spectral response. (Location: 84 F)

Key words: Remote sensing, vegetation assessment, aspen, white spruce

Fregren, D.H. 1980. The hardwoods future in Alberta. Pages 145-147 in J.A. McIntosh and M.N. Carroll, eds. *Utilization of western Canadian hardwoods. Proc. Symp.*, November 21-22, 1979, Prince George, British Columbia. Forintek Can. Corp., Vancouver, British Columbia. Spec. Publ. SP-2.

This paper provides a history of aspen use in Alberta since the early 1950s. It was apparent that use of aspen has risen and fallen on several occasions, and many companies have returned to using white spruce. The author outlines reasons for discontinuation of aspen use. (Location: Alberta)

Key words: Economics—fiber, aspen

Froning, K. 1980. Logging hardwoods to reduce damage to white spruce understory. *Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-229.*

This study assesses the loss and damage to the spruce understory at various densities during conventional aspen harvesting and to develop an economically feasible logging method for minimizing damage. Results suggest that damage and destruction are not related to understory density. Careless skidding caused considerable damage and destruction. The recommendations of the study include special harvesting plans, crew training, and use of suitable equipment. (Location: 63 D)

Key words: Understory protection, aspen, forest harvesting effects

Fuller, T.K.; Keith, L.B. 1980a. Wolf population dynamics and prey relationships in north-eastern Alberta. *Alta. Environ., Alta. Oil Sands Environ. Res. Program*, Edmonton, Alberta. AOSERP Rep. 102.

This study summarizes wolf population dynamics with respect to available food resources, mortality prey habits on moose, impacts of disturbance, and other habits. During the study, it was found that wolves consumed 11–12% of the adult moose population in the general Alberta Oil Sands Environmental Research Program area. (Location: 74 D, E)

Key words: Furbearers, ungulates, wildlife distribution and diversity

Fuller, T.K.; Keith, L.B. 1980b. Woodland caribou population dynamics in northeastern Alberta. *Alta. Environ. Alta. Oil Sands Environ. Res. Program*, Edmonton, Alberta. AOSERP Rep. 101.

The dynamics of the caribou population in the Birch Mountain area are described in terms of population density and distribution, age composition, sex ratios, reproduction, movement, and habitat use. This report appears to have been in part the basis for a subsequent journal article (Fuller and Keith 1981). (Location: 74 D, E; 84 A, H)

Key words: Ungulates, wildlife distribution and diversity, black spruce

Fuller, T.K.; Keith, L.B. 1981. Woodland caribou population dynamics in northeastern Alberta. *J. Wildl. Manage.* 45:197–213.

This report describes the population dynamics of the woodland caribou in the Birch Mountains during the period of January 1976 to June 1978. This study was conducted to assess the influence of Athabasca oil sands activities. Black spruce muskeg was the most commonly used habitat in the study area. (Location: 74 D, E; 84 A, H)

Key words: Ungulates, wildlife distribution and diversity, black spruce

Gál, J.; Bella, I.E. 1994. New stem taper functions for 12 Saskatchewan timber species. *Nat. Resour. Can., Can. For. Serv., Northwest Reg.,*

North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-338.

Height and diameter data from several common boreal mixedwood tree species are fitted to three polynomial regression models to estimate stem volume (K1, K2, and Hilt function). The intent was to determine if the volumes of small-diameter trees were under-estimated. Results indicate that K1 and K2 function estimates were within ± 3 years for upland trees. The Hilt function estimates were similar except for white spruce, black spruce and balsam fir, which were underestimated by 4–5%. (Location: Saskatchewan)

Key words: Growth and yield, white spruce, black spruce, balsam fir, lodgepole pine, white birch, aspen, balsam poplar

Garden, A.; Davies, R.W. 1988. The effects of a simulated acid precipitation on leaf litter quality and the growth of a detritivore in a buffered lotic system. *Environ. Pollut.* 52:303–313.

The effects of acid rain were experimentally tested on balsam poplar. The study shows that nitrogen content in the test leaf litter was reduced as was decomposition rates and the growth of *Tipula commiscibilis* with increased acidity. (Location: Not applicable; laboratory study)

Key words: Pollution effects, balsam poplar, pest control

Ghitter, G.S.; Hall, R.J.; Franklin, S.E. 1995a. Variability of Landsat Thematic Mapper data in boreal deciduous and mixedwood stands with conifer understory. *Int. J. Remote Sens.* 16:2989–3002.

Conifer understory was mapped to three levels (nil, light, heavy) under five overstory classes that ranged from pure deciduous to a 60–40% of deciduous–coniferous mixedwood composition. These polygons were imported from an ARC/INFO GIS and overlaid onto Landsat Thematic Mapper digital data. Conifer understory was more easily separated when leaf-off and leaf-on imagery data to account for two stages of phenology were employed versus use of either date alone. Three possible subsets of understory classes were proposed based on

accuracies from linear discriminant analysis of 71 field sites. (Location: 84 F)

Key words: Remote sensing, vegetation assessment, aspen, white spruce

Ghitter, G.S.; Hall, R.J.; Franklin, S.E. 1995b. Identifying class structure of white spruce understory beneath deciduous or mixedwood stands for improved classification results. Pages 643-649 in H. Epp and C. Taylor, eds. Proc. 17th Can. Symp. Remote Sens., June 13-15, 1995, Saskatoon, Saskatchewan. Can. Remote Sens. Soc., Can. Aeronaut. Space Inst., Ottawa, Ontario, and Sask. Res. Council, Saskatoon, Saskatchewan.

Forest cover polygons of the boreal mixedwoods when overlaid onto a digital image were invariably mixed from the perspective of Landsat Thematic Mapper spectral responses. The intersection of a GIS understory polygon and Isodata classification resulted in more homogeneous areas, and greater spectral differentiation that was more suitable for a supervised classification than when used alone. (Location: 84 C, F)

Key words: Remote sensing, vegetation assessment, aspen, white spruce

Gibbard, D.A.; Sutherland, B.J. 1987. 1986 site preparation equipment trials in Alberta: Donaren 180D powered disk trencher, Sinkkila HMF scarifier. Can. For. Serv., North. For. Cent., Edmonton, Alberta., and Alta. For. Lands Wildl., For. Serv., Edmonton, Alberta. Can.-Alta. For. Resour. Dev. Agreement Rep.

The Donaren 180D effectively penetrated duff layers and consistently left clear furrows; however, the number of plantable sites was only 65-80% of maximum. No conclusive results were obtained regarding the Sinkkila HMF scarifier because of mechanical problems during the test. (Location: 84 E; 83 L, M)

Key words: Site preparation, vegetation control—mechanical

Giberson, W.G. 1988. Aluminum tolerance of *Betula papyrifera* Marsh., on naturally acidic soils. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

The effect and tolerance of *Betula* to aluminum in the soil was investigated in the Buffalo

Head Prairie area. Experiments showed decreased root elongation with increased aluminum concentration, but plants adapted to soils with high aluminum contents had greater root elongation than did specimens from sites with low concentrations. (Location: 84 G)

Key words: Soil and site conditions, ecology, white birch

Gilbert, F.F.; Nancekirell, E.G. 1982. Food habits of mink and otter in northeastern Alberta. Can. J. Zool. 60:1282-1288.

The fecal materials of both mink and otter provided an indication of the smaller vertebrate species that occurred in an area. This study was designed to determine the food habits of mink and otter in two contrasting natural habitats (lakes and streams), can be disrupted by oil sands exploitation. Results show that scats of these two species could be indicators of population size and distributional ranges of their prey species. (Location: 74 D, E)

Key words: Furbearers, wildlife-habitat assessment, wildlife distribution and diversity

Gill, D. 1974. Snow damage to boreal mixedwood stands in northern Alberta. For. Chron. 50:70-73.

The impact of one brief weather event on forest stands in the boreal mixedwood is summarized, with emphasis on the intensity and extent of snow damage that occurred during near-freezing temperatures. Deciduous trees were more damaged than conifers. Stem breakage was not associated with trunk rot or other similar defects. Stems over 8 cm in diameter were the most susceptible. (Location: 74 D, E; 83 P)

Key words: Climate and related effects, vegetation assessment, forest-damage agents

Gorman, J.R., comp. 1985. Proceedings of the 1984 mechanized silviculture workshop, February 29-March 2, 1984, Edmonton, Alberta. Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-272.

Workshop participants reviewed the various types of equipment used in silviculture. Contributors from various sources discussed the use and development, and assessment of

site-preparation tools. Information is provided on economics and safety issues. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Site preparation, soil and site conditions, silviculture

Gower, D. 1989. Fate of labelled nitrogen fertilizer in limed, elemental sulphur-laden forest soils. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

The potential role of nitrogen fertilizer in the reclamation of acidified soils was investigated. Results suggest that nitrogen is most effective when ammonium is used rather than nitrate, and multiple light applications and greater qualities are used on more severely affected sites. (Location: 83 B)

Key words: Soil and site conditions, reclamation, pollution effects

Gould, J. 1999. Plant species of special concern. Alta. Nat. Herit. Inf. Cent., Edmonton, Alberta and Alta. Environ. Prot., Edmonton, Alberta.

A working list of 479 vascular and 275 non-vascular plant species considered provincial significant is presented. Included with the list are relative ratings of rarity based on the number of known occurrences of the species within the province. Some of these species were also significant at the national level. See Argus and Pryer 1990. (Location: Alberta)

Key words: Unique resources

Grabowski, T.I.J.; Heidt, J.; Titus, S.J. 1981. An improved stand growth model for trembling aspen in the prairie provinces of Canada—final report. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. ENFOR P-102.

A series of regression models was developed to predict various characteristics of aspen growth, such as mortality, diameter growth, height-age, volume, and biomass. The authors conclude that the models worked fairly well (error rate of about 10%). (Location: Alberta, Saskatchewan, Manitoba)

Key words: Growth and yield, aspen

Grant, D. 1980. Volume of B.C. interior hardwood resources. Pages 17–22 in J.A. McIntosh and M.N. Carroll, eds. Utilization of western Canadian hardwoods. Proc. Symp., November 21–22, 1979, Prince George, British Columbia. Forintek Can. Corp., Vancouver, British Columbia. Spec. Publ. SP-2.

The quantities of deciduous trees in each forest region of British Columbia are summarized. In the northeastern portion of the province, aspen represented approximately 69% of the total volume of mature broadleaf trees. (Location: British Columbia)

Key words: Aspen, balsam poplar, economics—fiber, tree-crop production

Green, J.E. 1980a. Small mammal populations of northeastern Alberta: I. Populations in natural habitats. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 107.

The purpose of this study was to collect abundance, distribution, and habitat-preference data for small mammals and hares for comparison with reclaimed areas. The best habitats for small mammals were found to be balsam poplar stands and early successional sites. (Location: 74 D, E)

Key words: Small mammals, wildlife-habitat assessment, wildlife-habitat distribution and diversity, furbearers, balsam poplar

Green, J.E. 1980b. Small mammal populations of northeastern Alberta: II. Populations in reclamation areas. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 108.

This study examines small rodent demography, compares the populations on natural and disturbed habitats, and looks at small rodent use of and damage to woody plants on reclaimed sites. The author concludes that reclaimed vegetation is generally not a severe impediment to use by rodents. (Location: 74 D, E)

Key words: Small mammals, reclamation, environmental impacts

Grewal, H. 1995. Parent stand age and harvesting treatment effects on juvenile aspen biomass productivity. For. Chron. 71:299–303.

The effects of aspen stand age at the time of harvesting (10–15, 30–35, and 55–60 years) and two harvesting methods (partial and full tree removal) were compared to determine if differences resulted in biomass production of aspen and the understory vegetation. Results indicate that harvested young stands produced taller trees with more branches than older stands, but produced less grass biomass. The harvesting methods did not show a consistent age-related response, although differences were found among age classes. (Location: 83 O, P)

Key words: Forest-harvesting effects, aspen, growth and yield, reforestation

Grewal, H.S. 1988. Biomass productivity in two-year-old aspen cutovers near Calling Lake and Slave Lake, Alberta. Pages 124–128 in C. Granger, ed. *Proc. Sixth Can. Bioenergy R & D Semin.*, February 16–18, 1987, Richmond, British Columbia. Elsevier Appl. Sci. Publ. Ltd., New York, New York.

This study compares the biomass productivity of 2-year-old aspen cover with the vegetation that existed prior to clear-cutting. Precutting test plots ranged from 10–15, 30–35, and 55–60 years old. It is concluded that stand age of harvesting did affect the productivity of regenerated vegetation, but that site productivity is a more significant factor. (Location: 83 O, P)

Key words: Aspen, juvenile stand-tending, tree-crop production, forest-harvesting effects

Gullion, G.W. 1986. *Managing northern forests for wildlife*. The Ruffed Grouse Soc., Corapolis, Pennsylvania.

This paper focuses on the management of aspen woodlands to enhance and maintain grouse habitat. Included in the report are recommendations on forest-harvesting methods and stand-tending practices to improve ruffed grouse habitat. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Wildlife-habitat assessment, birds, aspen, forest-harvesting effects

Hall, R.J.; Aldred, A.H. 1992. Forest regeneration appraisal with large-scale aerial photographs. *For. Chron.* 68:142–150.

The operational feasibility of using large-scale aerial photographs to quantify coniferous forest stocking and regeneration density was assessed in six cutovers. Aerial photographs were obtained in the spring prior to leaf-out because the foliage of aspen trees and deciduous shrubs mask the detection of coniferous regeneration during the growing season. Stocking estimates were on average, only 5% lower than field survey results and could be calibrated using regression techniques. The use of large-scale photos to quantify density in stems per hectare was also evaluated, and considered feasible if large standard errors can be tolerated. (Location: Saskatchewan)

Key words: Remote sensing, vegetation assessment, reforestation, jack pine, aspen

Hall, R.J.; Crown, P.H.; Titus, S.J. 1984. Change detection methodology for aspen defoliation with LANDSAT MSS digital data. *Can. J. Remote Sens.* 10:135–142.

The objective of this study was to develop a method for detecting and mapping forest tent caterpillar defoliation of aspen by using digital remote-sensing techniques. A three-spectral-band combination was found to be the most effective. The proposed method was considered reliable when more detailed field data were not available. (Location: Alberta)

Key words: Remote sensing, forest-damage agents, aspen

Hall, R.J.; Klita, D.L. 1997. Remote sensing - GIS integration: progress toward defining a conifer understory classification system for use with Landsat TM data. Pap. 63, Sess. E-3 in *Proc. Int. Symp. Geomatics Era Radarsat '97* 19th Can. Symp. Remote Sens., May 25–30, 1997, Ottawa, Ontario. Nat. Resour. Can., Geomatics Can., Ottawa, Ontario, and Natl. Def., Ottawa, Ontario. Compact Disk.

Detecting the presence and spatial distribution of conifer understory within hardwood and mixedwood stands is a significant management problem in boreal mixedwood forests. A prerequisite to the development of a land-cover classification system is to understand the influence of stand structure on Landsat Thematic Mapper spectral response. Understory land cover classes mapped at 15, 30, and 40 classes

were compared by image channel and a vegetation index (NDVI). There was a significant improvement in spectral separability from the 15 to 30 class systems, which suggests that incorporation of crown closure into the classification system is important. The NDVI is an indicator of living vegetation biomass, and its index value increased for all overstory stand structures as the amount of conifer understory increased. (Location: 84 C, F)

Key words: Remote sensing, vegetation assessment, aspen, white spruce

- Hall, R.J.; Still, G.N.; Crown, P.H. 1983. Mapping the distribution of aspen defoliation using LANDSAT color composites. *Can. J. Remote Sens.* 9:86-91.

A visual interpretation method was used to identify areas with aspen and balsam poplar that had been defoliated by forest tent caterpillar, and this method was compared to an aerial survey map of the same area. The map produced from visual interpretation of Landsat imagery delineated affected areas more accurately than the aerial survey map. Two potential uses of satellite remote sensing are to undertake mapping of defoliated areas that would not otherwise be surveyed, and to provide a flight-planning aid for future aerial surveys. (Location: 73 M, N; 74 C, D)

Key words: Remote sensing, forest-damage agents, vegetation assessment, aspen

- Hall, R.J.; Volney, W.J.A.; Knowles, K. 1995. Hazard rating and stand vulnerability to jack pine budworm defoliation using GIS. Pages 121-132 in W.J.A. Volney, V.G. Nealis, G.M. Howse, A.R. Westwood, D.R. McCullough, and B.L. Laishley, eds. *Jack pine budworm biology and management*. Proc. Jack Pine Budworm Symp., January 24-26, 1995, Winnipeg, Manitoba. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-342.

A spatial hazard rating system for assessing forest stand vulnerability to jack pine budworm damage was evaluated for an outbreak that occurred over a provincial forest located within the boreal area of Saskatchewan. The hazard rating system was considered an important component of the Jack Pine Budworm

Decision Support System. The hazard rating map was not strongly associated with a map of defoliation damage. Recommendations are made to incorporate knowledge of associations between stands that have sustained damage and their structural characteristics. (Location: 73 H)

Key words: Vegetation assessment, forest-damage agents, jack pine

- Halliday, W.E.D. 1935. Report on vegetation and site studies, Clear Lake, Riding Mountain National Park, Manitoba, 1932. Can. Dep. Inter., For. Serv., Ottawa, Ontario. Res. Note 42.

This report is an early study of the soils and vegetation in the Riding Mountain area. The soils are described, and the vegetation assessment includes understory and overstory relevé data. Individual species are organized according to soil-moisture regime. This is an interesting study from a historical perspective. (Location: 62 K)

Key words: Vegetation assessment, soil and site conditions, ecology

- Halliwel, D.H.; Apps, M.J.; Price, D.T. 1995. A survey of the forest site characteristics in a transect through the central Canadian boreal forest. *Water Air Soil Pollut.* 82:257-270.

A series of plots was surveyed along a transect from the aspen parkland in Saskatchewan to west of Thompson, Manitoba. The southern plots of this transect appeared to occur within the boreal mixedwood forest zone. The purpose of this survey was to estimate stand productivity, composition, debris, and soil characteristics within the plots as a basis for future monitoring of global climatic change. (Location: 63 E, L; 73 H, I)

Key words: Climatic and related effects, pollution effects, vegetation assessment, soil and site conditions

- Hammond, H.E.J. 1996. Arthropod biodiversity of *Populus* spp. coarse woody material in north-central Alberta. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

The arthropod populations of snags and downed logs in 40- to 100-year-old mixedwood stands were assessed with respect to abundance

and diversity, with special attention on beetles. It was found that diversity levels were similar among stands, but that some species were more dependent upon conditions associated with older stands. Species richness was found to be greater in recently harvested stands compared to older stands. The author concludes that extensive clear-cut logging could negatively affect arthropod populations. (Location: 73 L; 84 D)

Key words: Invertebrates, ecology

Hanley, P.T. 1973. Biophysical analysis and evaluation of capability: Fort McMurray-Gregoire Lake area. Alta. Lands For., Land Use Assignment Branch, Edmonton, Alberta.

A biophysical analysis (1:126 720) was presented for the Gregoire Lake area south of Fort McMurray. The classification is strongly oriented toward physical resources. Each ecosystem is rated for agriculture, forestry, ungulates, recreation, and waterfowl capability. (Location: 74 D)

Key words: Ecological land classification, land evaluation

Hansen, C.R. 1995. Genetic variation in early field performance of white spruce (*Picea glauca* (Moench) Voss) in central Alberta. M.Sc. thesis, Univ. Alta, Edmonton, Alberta.

A comparison of planted 8- and 10-year-old white spruce seedlings grown from seed collected from 150 "superior" trees found most of the variance in height growth (about 50%) was site-related rather than genetically related (2-3%). Site was less important in explaining mean increment variation. (Location: 83 O, P; 84 B)

Key words: Reforestation, genetics and cellular structure, white spruce

Hardy Associates (1978) Ltd. 1979. Cold Lake Project, final environmental impact assessment. Esso Resour. Can. Ltd., Calgary, Alberta.

A biophysical analysis was conducted in an area west of Cold Lake. It included an ecological land classification (1:25 000) and assessment of potential environmental impacts from oil development and emissions on the ecology of

the area. Most of the terrestrial resource data are very general. (Location: 73 E, L)

Key words: Ecological land classification, land evaluation, pollution effects, wildlife distribution and diversity, ungulates, birds, furbearers, small mammals, reclamation, vegetation classification

Hardy Associates (1978) Ltd. 1980. Soil survey, materials suitability and availability for reclamation and land use capabilities in the ALSANDS Project Area. ALSANDS Proj. Group, Calgary, Alberta.

A detailed soil survey was conducted within the vicinity of the proposed ALSANDS plant. This analysis includes 1:20 000-scale maps, profile descriptions, and laboratory analyses of selected soil series. A general description of associated overstory and understory vegetation is also provided. Each soil series is rated for forest capability according to the Canada Land Inventory system. (Location: 74 E)

Key words: Soil survey, soil and site conditions, vegetation assessment, land evaluation

Hardy Associates (1978) Ltd. 1981. Forest depletion by energy development in the green area of Alberta. Alta. Energy Nat. Resour., Edmonton, Alberta. Rep. T/24.

At the end of 1979, it was estimated that 3200 km² (approximately 1%) of Alberta's forested lands were disturbed by energy exploration and development. This study reports that most of the disturbances were seismic lines, which accounted for 70% of the disturbed area. (Location: Alberta)

Key words: Environmental impacts, economics—fiber

Harris, W.C. 1980. Guide to forest understory vegetation in Saskatchewan. Sask. Tourism Renewable Resour., For. Branch, Regina, Saskatchewan. Tech. Bull. 9.

This report is a guide to the identification of forest understory plants in Saskatchewan, which are indicators of forest-site conditions. The report includes common mosses, lichens, primitive vasculars, grasses, forbs, and shrubs, and provides photographs of each species. (Location: Saskatchewan)

Key words: Vegetation assessment, soil and site conditions

Harris, W.C.; Kabzems, A.; Kosowan, A.L.; Padbury, G.A.; Rowe, J.S. 1983. Ecological regions of Saskatchewan. Sask. Parks Renewable Resour., For. Div., Regina, Saskatchewan. Tech. Bull. 10.

Six ecoregions and 13 ecodistricts in Saskatchewan were mapped and described. Each description includes climate, terrain features, vegetation, wildlife, resources, and land use. The moisture and site conditions occupied by various trees are illustrated in several tables. (Location: Saskatchewan)

Key words: Ecological land classification, climate and related effects, soil and site conditions, wildlife distribution and diversity

Hauge, T.M.; Keith, L.B. 1981. Dynamics of moose populations in northeastern Alberta. J. Wildl. Manage. 45:573-597.

From January 1976 to June 1978, an intensive study of moose was conducted in northeastern Alberta (25 000-km² area). Results show that the moose population was either static or declining, and suggest that moose should not be subjected to hunting pressures. (Location: 74 D)

Key words: Wildlife distribution and diversity, ungulates

Hay, W.K.; O'Leary, D. 1988. Integrated resource inventory of the Wandering River study area. Alta. For. Lands Wildl., Land. Inf. Serv. Div., Edmonton, Alberta. Tech. Rep. T/178.

Physiography and surficial materials are the primary focus of this study (approximately 10 000 km² in the study area). An ecosection map at 1:100 000 scale is provided. Forest and agriculture capability were assessed on the basis of physical-site characteristics. Suitability ratings were also developed for various wildlife species. (Location: 83 P)

Key words: Physical land classification and geology, land evaluation

Hay, W.K.; Vettman, J.M.; Haag, R.W. 1985. Integrated resource inventory of the East Beaver Lake assessment area. Alta. Energy Nat.

Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/79.

A physical land classification and forage inventory (1:15 000 scale) were conducted in a 43-km² area along the east side of Beaver Lake. Eleven community-types are recognized and described. Plot data are provided in an appendix. (Location: 73 L)

Key words: Physical land classification and geology, forest grazing, soil and site conditions, vegetation classification

Head, W.K.; Anderson, D.W.; Ellis, J.G. 1981. The soils of the Wapawekka map area (73-1), Saskatchewan. Univ. Sask., Ext. Div., Sask. Inst. Pedol., Saskatoon, Saskatchewan. Publ. SF5.

A soils inventory was conducted in an area north of Prince Albert (14 244 km²) and a 1:126 720-scale map depicting soil associations was prepared. Ratings were developed for forest and agricultural capability. Area estimates are provided for each soil association as well as physical and chemical analysis data for selected associations. The areas of various forest cover types are summarized by height classes. (Location: 73 I)

Key words: Soils survey, land evaluation, tree-crop production

Heidt, J. 1983. Clonal variation in height growth of trembling aspen in central Alberta. Agric. For. Bull. 6(3):20-23.

This study reveals that aspen clones had significantly different heights at defined ages as well as different height growth patterns. The author suggests that several trees from different clones are necessary for reliable stand-volume estimates. (Location: 83 J)

Key words: Genetics and cellular structure, tree-crop production, aspen

Henderson, C. 1987. Aspen management practices in Alberta. Pages 71-76 in Aspen quality workshop. Proc., February 12, 1987, Edmonton, Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. For. Lands Wildl., Alta. For. Serv., Edmonton, Alberta. Can.-Alta. For. Resour. Dev. Agreement Rep.

This paper reviews the problems associated with hardwood harvesting of the boreal forest. These problems include a high proportion of cull in overmature stands, and the presence of coniferous trees in the overstory and understory. (Location: Alberta)

Key words: Forest policy, aspen, forest-damage agents, forest-harvesting effects

Hennan, E.; Munson, B. 1979. Species distribution and habitat relationships of waterfowl in northeastern Alberta. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 81.

This waterfowl study determined species abundance, diversity, and habitat associations. Even though the significance of individual wetlands in terms of duck numbers and densities varied throughout the season, Little McClelland Lake, Wet Muskeg Lake, Wood Slough, Gordon Lake, Saline Lake, and Algar Lake appeared consistently important. (Location: 74 D, E)

Key words: Wildlife distribution and diversity, birds, wildlife-habitat assessment

Hildahl, V.; Campbell, A.E. 1975. Forest tent caterpillar in the prairie provinces. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-135.

The distribution of forest tent caterpillar infestations are summarized for three different time periods between 1950 and 1971. The life history, effects, and possible natural and chemical controls of the forest tent caterpillar are discussed. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-damage agents, aspen, balsam poplar, pest control

Hildahl, V.; Hiratsuka, Y. 1991. Yellow-bellied sapsucker. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 2.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of yellow-bellied sapsuckers. (Location: Canada)

Key words: Forest-damage agents, pest control

Hildahl, V.; Reeks, W.A. 1960. Outbreaks of the forest tent caterpillar, *Malacosoma disstria* Hbn., and their effects on stands of trembling aspen in Manitoba and Saskatchewan. Can. Entomol. 92:199-209.

Both Saskatchewan and Manitoba experienced forest tent caterpillar infestations almost every year between 1923 and 1953. This study reports on these infestations, and concludes that, although defoliation was not sufficiently severe to cause mortality, it did cause increment loss of approximately 8% of the basal area. (Location: Saskatchewan, Manitoba)

Key words: Forest-damage agents, aspen

Hilton, J.E.; Bailey, A.W. 1974. Forage production and utilization in a sprayed aspen forest in Alberta. J. Range Manage. 27:375-380.

This study investigated the efficacy of spraying 2,4-D on aspen forests to increase forage production for cattle. Two years after spraying an aspen forest with as little as 3.6 kg/ha, annual forage production was 1024 kg/ha; the control produced 219 kg/ha. (Location: 83 H)

Key words: Vegetation control—chemical, forest grazing, aspen

Hiratsuka, Y. 1987. Forest tree diseases of the prairie provinces. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-286.

This report includes summaries on various diseases that affect trees in the prairie provinces. These summaries include information on each disease's effect, distribution, hosts, symptoms, disease cycle, damage, possible control, and photographs of the disease's effect. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-damage agents, white spruce, jack pine, lodgepole pine, black spruce, aspen, balsam poplar

Hiratsuka, Y. 1994. Spruce needle rusts. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 25.

This leaflet summarizes factors such as distribution and hosts; symptoms, signs, and damage; causal agent; and prevention and control of spruce needle rust. (Location: Canada)

Key words: Forest-damage agents, white spruce, black spruce, pest control

- Hiratsuka, Y.; Gibbard, D.A.; Bakowsky, O.; Maier, G.B. 1990. Classification and measurement of aspen decay and stain in Alberta. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-314.

Various diseases are described and related to the use of aspen. The volumes of aspen wood available from various forests of Alberta are tabulated. The use of an H-Gun for sampling wood hardness is described. (Location: Alberta)

Key words: Forest-damage agents, aspen

- Hiratsuka, Y.; Langor, D.W.; Crane, P.E. 1995. A field guide to forest insects and diseases of the prairie provinces. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. Spec. Rep. 3.

The symptoms and signs, causes, distribution and hosts, disease cycle, and damage caused by various forest-damage agents are summarized. Agents are grouped according to coniferous and deciduous trees, and these groupings are subdivided based on the sites they attack (e.g., foliage and buds, roots, stems and branches, seedlings, cones). (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-damage agents, aspen, white spruce, black spruce, balsam poplar

- Hiratsuka, Y.; Loman, A.A. 1984. Decay of aspen and balsam poplar in Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-262.

The major decay-causing agents of aspen and balsam poplar in Alberta are reviewed, and the percentage occurrence of various diseases are summarized. Some of the summaries are on the basis of age classes. Most decay in aspen and balsam poplar is associated with the occurrence of *Phellinus termulae*. (Location: Alberta)

Key words: Forest-damage agents, aspen, balsam poplar

- Hiratsuka, Y.; Maruyama, P. 1991. Western gall rust. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 3.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of western gall rust. (Location: Canada)

Key words: Forest-damage agents, jack pine, lodgepole pine, pest control

- Hogg, E.H. 1994. Climate and southern limit of the western Canadian boreal forest. Can. J. For. Res. 24:1835-1845.

Selected climatic parameters are compared along the aspen parkland and boreal forest boundary. The southern limit of the boreal zone was found to correspond with the zero isoline, where precipitation and potential evaporation were balanced. The southern limit of white spruce, jack pine, and lodgepole pine also corresponded generally with the zero-moisture-index isoline; however, white spruce extended its range into drier areas by growing on river valley sites where moisture conditions were favorable. The distribution of black spruce and tamarack was related to the southern limits of peatlands. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Climate and related effects, ecology, white spruce, jack pine, lodgepole pine

- Hogg, E.H.; Hurdle, P.A. 1995. The aspen parkland in western Canada: a dry-climate analogue for the future boreal forest? Water Air Soil Pollut. 82:391-400.

This study evaluates the potential effects of a 4-5°C temperature and 11% precipitation increase resulting from a doubling of atmospheric carbon dioxide on the mixedwood forest zone. The authors conclude that the increase in precipitation would not offset the increased evaporation rate, and as a result, boreal forests would become drier and currently dry mixedwood stands might develop into parkland. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Climate and related effects, pollution effects, economics—fiber, aspen

- Hogg, E.H.; Lieffers, V.J. 1991a. The impact of *Calamagrostis canadensis* on soil thermal regime after logging in northern Alberta. Can. J. For. Res. 21:387-394.

The effects of mowing of *Calamagrostis canadensis* on forest soil temperature were evaluated. Data suggest that mowed areas had warmer soil due to less insulation by a litter layer. Cooler soil temperatures could impede tree seedling growth. (Location: 83 P)

Key words: Forest-harvesting effects, vegetation control—*Calamagrostis*, site preparation, climate and related effects, ecology

- Hogg, E.H.; Lieffers, V.J. 1991b. The relationship between seasonal changes in rhizome carbohydrate reserves and recovery following disturbance in *Calamagrostis canadensis*. Can. J. Bot. 69:641–646.

The seasonal growth pattern and food reserves of *Calamagrostis canadensis* were investigated to determine if the plant might be more easily controlled if mowed at a particular time in the summer. The results found, however, that carbohydrate reserves are a poor predictor of regrowth potential. (Location: 83 P)

Key words: Forest-harvesting effects, vegetation control—*Calamagrostis*, site preparation, ecology

- Hogg, E.H.; Lieffers, V.J. 1991c. Seasonal changes in shoot regrowth potential in *Calamagrostis canadensis*. Oecologia 85:596–602.

This study examines seasonal change in the shoot growth of *Calamagrostis canadensis* following disturbance. The first objective was to determine the relationship between seasonal change and nitrogen content. A second objective was to determine if seasonal changes were influenced by light. (Location: 83 P)

Key words: Vegetation control—*Calamagrostis*, soil and site conditions, climate and related effects, ecology

- Holland, W.D.; Nemeth, Z.J. 1974. Description of soil site characteristics and forest growth in selected areas of northwestern Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. File Rep. NOR-015.

The general physical and site characteristics are described for soils in the High Level, Manning, Clear River, and Whitecourt areas. Regression models were developed for soil-density and root-abundance relationships. Better tree growth was associated with soils

that had deep rooting and lacked compacted subsoils. (Location: 83 K; 84 D, E, K)

Key words: Soil and site conditions, ecology, land evaluation

- Holmsen, S.D. 1988. Stand cleaning with Husqvarna 165RX clearing saws in northern Alberta. For. Eng. Res. Inst. Can., Pointe Claire, Québec. Tech. Note TN-116.

The cost was calculated for thinning aspen-dominated stands with a 165RX Husqvarna saw. Cost per-hectare is estimated at \$400, based on a labor wage of \$15/hour. It was found that 13% of the crop seedlings were covered with slash from thinning. (Location: 83 L)

Key words: Vegetation control—mechanical, juvenile stand-tending, aspen, white spruce

- Holowaychuk, N.; Fessenden, R.J. 1987. Soil sensitivity to acid deposition and the potential of soils and geology in Alberta to reduce the acidity of acidic inputs. Alta. Res. Council, Nat. Resour. Div., Terrain Sci. Dep., Edmonton, Alberta. Earth Sci. Rep. 87-1.

A map (1:2 000 000 scale) was prepared that depicts the sensitivity of soils in Alberta to acidification from pollution, while a second map summarizes the potential of soils and geology to mitigate the effects of increased acidity. Extensive legends and appendixes provide attribute data for each map polygon. (Location: Alberta)

Key words: Pollution effects, soils and site conditions

- Horton, K.W.; Hopkins, E.J. 1965. Influence of fire on aspen suckering. Can. Dep. For., For. Res. Branch, Ottawa, Ontario. Publ. 1095.

This study examines prescribed burning as a technique to manage aspen suckering. Results show that intensive burning is ineffective for sucker control; moderate burning maximizes suckering; and light burning is undesirable because it does not result in a sufficient density of suckers for stand development and allow dense understory vegetation to develop. (Location: Not specified)

Key words: Fire management and effects, aspen, vegetation assessment

Howitt, R.W. 1981. Dynamics of a gray luvisol. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

A detailed chemical and physical analysis, as well as site temperature and moisture monitoring, were done on a Gray Luvisolic soil under a mixed aspen-white spruce stand in the Breton area. The author reports that the LFH horizon inhibited water movement into the solum; ice promoted the development of platy structure in the Ae horizon; and the translocation of iron, aluminum, and organic constituents was related to water movement through the profile. (Location: 83 G)

Key words: Soil and site conditions, climate and related effects

Howlett, M. 1989. The forest industry on the prairies: opportunities and constraints to future development. Prairie Forum 14:233-258.

This paper discusses the development and current situation of the forest industry in each of the prairie provinces, as well as the constraints on and opportunities for future development. It also presents a historical perspective on the two major periods of economic expansion: the lumbering period prior to the mid-1940s, and the current cycle of pulp and paper development, which is most prevalent in Alberta. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Economics—fiber

Huang, S. 1994a. Ecologically based individual tree volume tables for aspen (*Populus tremuloides* Michx.). Alta. Environ. Prot., Land For. Serv., For. Manage. Div., Edmonton, Alberta. Publ. T/298.

This report provides individual tree volume equations for aspen in Alberta. Equations were developed on a natural regions basis and associated volumes are provided. (Location: Alberta)

Key words: Growth and yield, aspen

Huang, S. 1994b. Ecologically based individual tree volume tables for black spruce (*Picea mariana* (Mill.) B.S.P.). Alta. Environ. Prot., Land For. Serv., For. Manage. Div., Edmonton, Alberta. Publ. T/295.

This report provides individual tree volume equations for black spruce in Alberta. Equations were developed on a natural regions basis and associated volumes are provided. (Location: Alberta)

Key words: Growth and yield, black spruce

Huang, S. 1994c. Ecologically based individual tree volume tables for lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.). Alta. Environ. Prot., Land For. Serv., For. Manage. Div., Edmonton, Alberta. Publ. T/296.

This report provides and individual tree volume equations for lodgepole pine in Alberta. Equations were developed on a natural regions basis and associated volumes are provided. (Location: Alberta)

Key words: Growth and yield, lodgepole pine

Huang, S. 1994d. Ecologically based individual tree volume tables for softwood groups. Alta. Environ. Prot., Land For. Serv., For. Manage. Div., Edmonton, Alberta. Publ. T/299.

This report provides individual tree volume equations for major softwood species in Alberta. Equations were developed on a natural regions basis and associated volumes are provided. (Location: Alberta)

Key words: Growth and yield, white spruce, balsam fir, black spruce, lodgepole pine, jack pine

Huang, S. 1994e. Ecologically based individual tree volume tables for white spruce (*Picea glauca* (Moench) Voss). Alta. Environ. Prot., Land For. Serv., For. Manage. Div., Edmonton, Alberta. Publ. T/294.

This report provides individual tree volume equations for white spruce in Alberta. Equations were developed on a natural regions basis and associated volumes are provided. (Location: Alberta)

Key words: Growth and yield, white spruce

Huang, S. 1994f. Provincial-based individual tree volume tables for Douglas-fir, white birch, tamarack, Engelmann spruce and jack pine. Alta. Environ. Prot., Land For. Serv., For. Manage. Div., Edmonton, Alberta. Publ. T/300.

This report provides individual tree volume equations for major tree species in Alberta. Equations were developed on a natural regions basis and associated volumes are provided. (Location: Alberta)

Key words: Growth and yield, white birch, jack pine

Huang, S. 1994g. Summary of equations and estimated coefficients for ecologically based individual tree volume estimation in Alberta. Alta. Environ. Prot., Land For. Serv., For. Manage. Div., Edmonton, Alberta. Publ. T/292.

This report provides height-diameter and individual tree volume equations for major tree species in Alberta. Equations were developed on a natural regions basis and associated volumes are provided. (Location: Alberta)

Key words: Growth and yield, aspen, white spruce, balsam fir, black spruce, lodgepole pine, jack pine, balsam poplar

Huang, S. 1996. Modelling dynamics of regenerating juvenile stands for major Alberta tree species: growth intercept models for assessing the site potential of young lodgepole pine stands in Alberta. Alta. Environ. Prot., Land For. Serv., Edmonton, Alberta. Publ. T/339.

A series of polynomial regressions models to predict lodgepole pine site index (50 years) is presented. Separate equations were developed for different climatic zones, including the Lower Boreal-Cordilleran ecoregion. Average leader length during the last 3, 4, or 5 years of growth is used as the dependent variable. The developed models closely approximate those used in Phase 3 forest cover mapping. (Location: Western Alberta)

Key words: Growth and yield, lodgepole pine

Huang, S.; Lakusta, T.W.; Giacobbo, S.M. 1994. Ecologically based individual tree volume tables for balsam poplar (*Populus balsamifera* L.). Alta. Environ. Prot., Land For. Serv., For. Manage. Div., Edmonton, Alberta. Publ. T/297.

This report provides individual tree volume equations for balsam poplar in Alberta. Equations were developed on a natural regions basis and associated volumes are provided. (Location: Alberta)

Key words: Growth and yield, balsam poplar

Huang, S.; Lakusta, T.W.; Held, R.J. 1994. Ecologically based individual tree volume tables for balsam fir (*Abies balsamea* (L.) Mill.). Alta. Environ. Prot., Land For. Serv., For. Manage. Div., Edmonton, Alberta. Publ. T/293.

This report provides individual tree volume equations for balsam fir in Alberta. Equations were developed on a natural regions basis and associated volumes are provided. (Location: Alberta)

Key words: Growth and yield, balsam fir

Huang, S.; Titus, S.J. 1995. An individual tree diameter increment model for white spruce in Alberta. Can. J. For. Res. 25:1455-1465.

A nonlinear-regression model for describing and predicting white spruce diameter growth in mixedwood forest stands was developed based on permanent plot data. The proposed model includes various tree and stand heights, diameters, and density variables; and explains approximately 65% of the variance in the data. This model indicates that stem diameter increment and tree size decrease with increasing stand density. (Location: Alberta)

Key words: Growth and yield, white spruce

Huang, S.; Titus, S.J. 1996. An age-independent individual tree height prediction model for boreal spruce-aspen stands in Alberta. Can. J. For. Res. 24:1295-1301.

A single nonlinear-regression model was developed for predicting white spruce and aspen height in boreal mixedwood forest stands. Among the parameters included in the model were stand-basal area, site-productivity index, average breast height diameter, composition, and the breast height and basal area of the prediction tree. The model explains more than 90% of the variance in data for both tree species. The components of the regression model suggest that tree height increases with increasing stand density to a limiting value, and stands with greater densities of white spruce also tend to have tall trees. (Location: Alberta)

Key words: Growth and yield, aspen, white spruce

Huang, S.; Titus, S.J.; Lakusta, T.W. 1994. Ecologically based individual tree volume tables for hardwood groups. *Alta. Environ. Prot., Land For. Serv., For. Manage. Div., Edmonton, Alberta. Publ. T/301.*

This report provides individual tree volume equations for hardwoods in Alberta. Equations were developed on a natural regions basis and associated volumes are provided. (Location: Alberta)

Key words: Growth and yield

Huang, S.; Titus, S.J.; Lakusta, T.W.; Held, R.J. 1994. Ecologically based individual tree height-diameter models for major Alberta tree species. *Alta. Environ. Prot., Land For. Serv., For. Manage. Div., Edmonton, Alberta. Publ. T/291.*

This report provides individual height-diameter models for major tree species in Alberta. Equations were developed on a natural regions basis and associated volumes are provided. (Location: Alberta)

Key words: Growth and yield, aspen, white spruce, balsam fir, black spruce, lodgepole pine, jack pine, balsam poplar

Hudson, R.J. 1975. A computer simulation study of the potential productivity of wildlife in the boreal mixedwood zone of Alberta. *Feeder's Day Rep.* 54:72-75.

The results of this study indicate that mixedwood forests are only moderately productive for native ungulate grazing. The author recommends improving wildlife habitat through logging and prescribed burning. Several population-growth scenarios are presented for bison, elk, and moose. (Location: Alberta)

Key words: Wildlife-habitat assessment, forest grazing, ungulates

Hunt, H.M. 1976. Big game utilization of hardwood cuts in Saskatchewan. Pages 91-126 in J.A. Hancock and W. Mercer, eds. *Proc. 12th North Am. Moose Conf. Workshop, March 23-26, 1976, St. John's, Newfoundland. North Am. Moose Conf., St. John's, Newfoundland.*

This study compares moose and elk use of cutover blocks during two winters, one of which was more severe than the other. During the colder winter ungulates ventured farther from cover. Older cuts were used more often than younger cuts, and patterns of cutting strongly influenced use patterns. (Location: 63 D)

Key words: Wildlife distribution and diversity, wildlife-habitat assessment, climate and related effects, forest-harvesting effects, ungulates

Hunt, H.M. 1978. Foods of elk in the boreal forest of Saskatchewan. *Sask. Dep. Tour. Renew. Resour. Wildl. Branch, Saskatoon, Saskatchewan. Wildl. Tech. Rep.* 78-9.

Not available for review. (Location: Saskatchewan)

Key words: Wildlife-habitat assessment, ungulates

IEC Beak Consultants Ltd. 1984. Final report on the distribution and abundance legend for the provincial overview assessment of wildlife resource status. *Alta. Energy Nat. Resour., Edmonton, Alberta.*

The abundance and distribution of 18 wildlife species are assessed with respect to a 1:1 000 000 provincial habitat district map developed by Knapik and Westworth (1984). Much of this assessment is based on a summation of historical field surveys. (Location: Alberta)

Key words: Vegetation assessment, wildlife distribution and diversity, ungulates, furbearers, birds

IEC Beak Consultants Ltd. 1985. Prototype assessment of wildlife resource status of the Rocky Mountain House sheet (83B). *Alta. Energy Nat. Resour., Fish Wildl. Div., Edmonton, Alberta.*

Habitat-wildlife species models were developed for moose, white-tailed deer, mule deer, elk, bighorn sheep, American marten, and dabbling ducks in the Rocky Mountain House area. These models were developed to predict current habitat suitability. Known and predicted population densities are compared to assess the reliability of the models. (Location: 83 B)

Key words: Wildlife-habitat assessment, ungulates, birds, furbearers

Intera Consultants Ltd. 1975. An impact assessment of forest vegetation and soils within a seven mile radius from the Great Canadian Oil Sands Ltd. complex. Great Canadian Oil Sands Ltd., Calgary, Alberta.

The vegetation and soils within the vicinity of a tar-sands processing plant were analyzed to determine if any measurable changes had occurred after 7 years of plant operation. Elevated sulfur content occurred in the soil samples, but could not be correlated to emissions. (Location: 74 D, E)

Key words: Pollution effects, vegetation assessment, soils and site conditions

Ip, D.W. 1992. Dwarf mistletoe. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 18.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of dwarf mistletoe. (Location: Canada)

Key words: Forest-damage agents, pest control

Ives, W.G.H. 1973. Heat units and outbreaks of the forest tent caterpillar, *Malacosoma disstria* (Lepidoptera: Lasiocampidae). Can. Entomol. 105:529-543.

The purpose of this study was to evaluate the relationship between heat units (accumulated degree-days) during a fixed overwintering period and a shifting larval feeding period for the forest tent caterpillar, based on areas of known infestations. Results suggest that years with increasing populations had cooler overwintering periods, and warmer and earlier feeding periods, than did those with decreasing populations. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-damage agents, climate and related effects, pest control, aspen

Ives, W.G.H. 1981. Environmental factors affecting 21 forest insect defoliators in Manitoba and Saskatchewan, 1945-69. Environ. Can., Can.

For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-233.

This study summarizes outbreak histories for 21 forest insect defoliators common to Manitoba and Saskatchewan. The abundance of these insects is related to weather data over the same time period. Results reveal that weather appears to be a major determiner of abundance of all studied insect species. From limited data, it also appears that birds, small mammals, parasites, invertebrate predators, and disease might also play important roles in particular circumstances. (Location: Saskatchewan, Manitoba)

Key words: Forest-damage agents, climate and related effects, birds, small mammals, invertebrates

Ives, W.G.H.; Muldrew, J.A. 1978. Preliminary evaluations of the effectiveness of nucleopolyhedrosis virus sprays to control the forest tent caterpillar in Alberta. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-204.

Preliminary results are presented from tests conducted in 1976-77 to determine if virus sprays might be valid alternatives to chemical insecticides for controlling tent caterpillar populations. Results reveal that mortality was quite high. There is evidence that the virus was carried over from earlier treatments, and that the infection spread as far as 4.6 km from the source area. (Location: 83 O)

Key words: Forest-damage agents, pest control

Ives, W.G.H.; Muldrew, J.A.; Smith, R.M. 1982. Experimental aerial application of forest tent caterpillar baculovirus. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-240.

This report presents the results of the aerial spraying of forest tent caterpillars with nuclear polyhedrosis virus, and assesses the amount of virus carry-over from previous years. The applications were made from 1976 to 1980 during the egg and larval development stages. High dosages resulted in increased mortality. It appeared the virus was carried over to subsequent generations in an area that was treated

with a hydraulic sprayer, but not in areas treated by aerial spraying. (Location: 83 J, O)

Key words: Forest-damage agents, pest control

- Ives, W.G.H.; Wong, H.R. 1988. Tree and shrub insects of the prairie provinces. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-292.

A comprehensive review is presented for more than 600 forest insects. Each species summary includes information on the distribution, hosts, life cycle, and damage caused. Also included is a bibliography with 657 related citations. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-damage agents

- Jackson, C. 1974. The deciduous timber resource and forest management policies of Alberta. Pages 6-15 in R.W. Neilson and C.F. McBride, eds. Poplar utilization symposium. Proc., May 23-24, 1974, Edmonton, Alberta. Can. Dep. Environ., Can. For. Serv., West. For. Prod. Lab., Vancouver, British Columbia. Inf. Rep. VP-X-127.

The deciduous forest resources of Alberta are described. The author estimates that a supply of 540 million m³ of aspen existed in Alberta in the study year. Legislation and policies regarding deciduous tree use as of 1974 are also summarized. (Location: Alberta)

Key words: Economics—fiber, forest policy, aspen

- Jameson, J.S. 1963. Comparison of tree growth on two sites in the Riding Mountain Forest Experimental Area. Can. Dep. For., For. Res. Branch, Ottawa, Ontario. Publ. 1019.

This report compares the growth of uneven-aged white spruce and aspen on two different sites. Results indicate significant growth differences in terms of number of merchantable trees, the rate of height growth, height of dominant trees at index age and index diameters, and the merchantable and total volumes. Differences are attributed to more favorable soil texture, structure, and moisture conditions. (Location: 62 K)

Key words: Uneven-aged stand management, soil and site conditions, soil and site productivity

- Jaques, D.; van Eck, P. 1980. Analysis and mapping of terrestrial ecosystems on the AMOCO Lease area, Gregoire Lake, Alberta. AMOCO Can. Petroleum Company Ltd., Calgary, Alberta.

A review was done of the biophysical resources within the vicinity of the AMOCO lease near Fort McMurray. Included in the report are the typing and sampling of plant communities, assessments of habitat suitability for wildlife, tree-growth potential, and a survey of surficial parent materials and soils. (Location: 74 D)

Key words: Vegetation classification, wildlife-habitat assessment, physical land classification and geology, environmental impacts, erosion assessments, land evaluations, ungulates, furbearers

- Jaquish, B.C. 1981. Natural variation in the leaf epicuticular wax alkanes and leaf wax morphology of trembling aspen (*Populus tremuloides* Michx.). M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

The epicuticular wax of aspen leaves is described with respect to inter- and intracolonial, temporal, sexual, and geographical variations. Because of these different sources of influence, the author reports considerable variability in the amount of wax on leaves. (Location: 83 H)

Key words: Genetics and cellular structure, aspen

- Jarvis, J.M. 1968. Silviculture and management of native poplar stands. Pages 70-87 in J.S. Maini and J.H. Cayford, eds. Growth and utilization of poplars in Canada. Can. Dep. For. Rural Dev., For. Branch, Ottawa, Ontario. Publ. 1205.

This paper describes the general ecology, range, volume, growth and yield, decay, silviculture and management, silvicultural research, and future market prospects of aspen and balsam poplar. Several tables of growth and volume values are provided, based on site quality. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Tree-crop production, forest-damage agents, growth and yield, silviculture, aspen, balsam poplar

Jarvis, J.M.; Stenecker, G.A.; Waldron, R.M.; Lees, J.A. 1966. Review of silvicultural research: white spruce and trembling aspen cover types, mixedwood forest section, boreal forest region, Alberta-Saskatchewan-Manitoba. Can. Dep. For. Rural Dev., For. Branch, Ottawa, Ontario. Publ. 1156.

The authors review 40 years of research by the Canadian Forestry Service in boreal mixedwood stands. Among the summarized topics are site preparation, site classification, cutting methods, and thinning of aspen. The study includes a good review of a variety of miscellaneous projects, many of which are not reported individually. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Site preparation, ecological land classification, juvenile stand-tending, growth and yield, forest-harvesting effects, aspen, white spruce

Jarvis, J.M.; Tucker, R.E. 1968a. Drought index as a predictor of moisture content in L and F horizons on an upland white spruce-trembling aspen cut-over area. Can. Dep. For. Rural Dev., For. Branch, Ottawa, Ontario. Publ. 1237.

This study attempts to determine if prescribed burning is a feasible technique for reducing the organic mantle on upland mixedwood cutover areas in the boreal forest. The authors found that moisture content in L and F horizons was correlated with the Drought Index. Prescribed burning alone was not considered sufficient site preparation for planting or seeding to conifers because the F horizon dries slowly and retains much moisture, which inhibits its removal during burning. (Location: 62 K)

Key words: Fire management and effects, soil and site conditions, site preparation

Jarvis, J.M.; Tucker, R.E. 1968b. Prescribed burning after barrel scarifying on a white spruce-trembling aspen cutover. Pulp Pap. Mag. Can. 69(21):70-72.

The purpose of the experiment reported here was to determine if fire would enhance white spruce colonization on aspen-white spruce sites after logging. The author suggests that this particular experiment was not very successful

because part of the duff layer remained intact. (Location: 62 K)

Key words: Fire management and effects, site preparation, white spruce, aspen

Jeffery, W.W. 1964. Forest types along Lower Laird River, Northwest Territories. Can. Dep. For., For. Res. Branch, Ottawa, Ontario. Publ. 1035.

Mixedwood forest communities along the Laird River from the British Columbia border to Nahanni Butte are described. These descriptions include general floristics, soils, ecological conditions, and geomorphic data and interpretations. Some height-age data are presented. (Location: Western Northwest Territories)

Key words: Vegetation assessment, soil and site conditions, ecology, physical land classification and geology

Jesberger, J.A.; Sheard, J.W. 1973. A quantitative study and multivariate analysis of corticolous lichen communities in the southern boreal forest of Saskatchewan. Can. J. Bot. 51:185-201.

This study investigates the structure and composition of corticolous lichen communities in the southern boreal forest of Saskatchewan to identify environmental factors that affected lichen distribution. Lichen distributions were found to be related to moisture levels and tree age. (Location: Saskatchewan)

Key words: Vegetation assessment, climate and related effects, ecology

Johnson, H.J. 1957. Empirical yield tables for aspen on the Riding, Duck, and Porcupine Mountains, Manitoba. Can. Dep. North. Aff. Natl. Resour., For. Branch, For. Res. Div., Ottawa, Ontario. Proj. MS-192.

For this study, height-age (50 year), stem density by age, age-diameter, age-basal area, and volume curves were developed for aspen. The report includes general summary statistics on tree dimensions and volume data based on 162 sample plots. (Location: 62 K, N; 63 C)

Key words: Growth and yield, tree-crop production

Johnson, H.J. 1985. A review of forest research studies conducted by the Canadian Forestry

Service in Manitoba and Saskatchewan to 1970. Can. For. Serv., North. For. Cent., Edmonton, Alberta. 3 Vols.

The types of information available for approximately 300 incomplete Canadian Forestry Service research studies from the years 1924 to 1970 in Saskatchewan and Manitoba are evaluated. These studies cover a wide range of topics; 18 studies are aspen- and mixedwood-oriented. Data were stored in the Canadian Forestry Service office in Winnipeg and Northern Forestry Centre in Edmonton. (Location: Saskatchewan, Manitoba)

Key words: Soil and site conditions, juvenile stand-tending, growth and yield, forest damage agents, ecological land classification, physical land classification and geology, tree-crop production, economics—fiber, silviculture, forest-harvesting effects, reforestation, site preparation, ecology, even-aged stand management, uneven-aged stand management, aspen, white spruce, jack pine, black spruce

Johnson, H.J. 1986. The release of white spruce from trembling aspen overstories: a review of available information and silvicultural guidelines. Can. For. Serv., Manit. Dist. Off., Winnipeg, Manitoba, and Manit. Nat. Resour., For. Branch, Winnipeg, Manitoba. Can.-Manit. For. Renew. Agreement Rep.

This report summarizes over 200 publications on the release of white spruce through aspen overstory removal in the Duck Mountain area. The author concludes that approximately one-third of the area might be suitable for treatment. There were several limitations that should be considered before proceeding with further study. (Location: 62 N)

Key words: White spruce, aspen, uneven-aged stand management, juvenile stand-tending, growth and yield, vegetation control—chemical, vegetation control—mechanical, ecology, economics—fiber

Johnson, H.J. 1987. A review of forest research studies conducted by the Canadian Forestry Service in Alberta to 1975. Can. For. Serv., North. For. Cent., Edmonton, Alberta.

Information available for approximately 220 incomplete Canadian Forestry Service research

studies in Alberta and Northwest Territories is evaluated. Studies were housed at the Northern Forestry Centre in Edmonton. These studies represent a wide range of topics. (Location: Alberta, Northwest Territories)

Key words: Growth and yield, economics—fiber, forest-harvesting effects, site preparation, soil and site conditions, fire ecology, ecology, fire management and effects, climate and related effects, small mammals, hydrology, white spruce, aspen, black spruce, lodgepole pine

Johnson, H.J.; Cerezke, H.F.; Endean, F.; Hillman, G.R.; Kiil, A.D.; Lees, J.C.; Loman, A.A.; Powell, J.M. 1971. Some implications of large-scale clearcutting in Alberta—a literature review. Can. Dep. Environ., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-6.

This literature review focuses on the following implications of large-scale clear-cutting in Alberta: environmental factors, silvicultural implications, probable hydrological effects, fire hazards, and insect and disease problems. Recommendations for mitigating these potential problems are provided. (Location: Alberta)

Key words: Forest-harvesting effects, hydrology, forest-damage agents, reforestation, fire management and effects

Johnson, H.J.; Gorman, J.R. 1977. Effects of strip width on the regeneration of white spruce in the mixedwood forest section of Alberta. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-188.

An analysis of partially clear-cut stands 16–24 ha in size suggests that seedling densities decreased with distance in to the cut area from the forest edge. Stocking rates were similar across the cut area, however, due in part to the importance of appropriate microsites needed for germination. The best stocking occurred when the cutting area was narrowest. (Location: 83 O; 84 C, K)

Key words: Site preparation, reforestation, white spruce, silviculture

Johnson, H.J.; Waldron, R.M. 1992. A review and field evaluation of forest research and development projects established by Forestry

Canada between 1920 and 1970, Riding Mountain National Park, Manitoba. For. Can., Northwest Reg., North. For. Cent., Manit. Dist. Office, Winnipeg, Manitoba.

This report reviews 71 research projects initiated by the Canadian Forest Service in Riding Mountain National Park. Each project review includes information on the type of study, dates of resampling, site conditions, recommendations for future work, and other notes. Location maps are provided. Approximately half of these studies were aspen or mixedwood related. (Location: 62 K)

Key words: Ecology, site preparation, forest-harvesting effects, forest-damage agents, vegetation control—mechanical

Johnston, M.H. 1981. The effects of fire disturbance level on plant re-establishment in Elk Island National Park, Alberta. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

The effects of prescribed burning on understory plants are examined to determine the importance of fire intensity on plant re-establishment and to identify regeneration mechanisms. Results suggest that one-third of species regenerate from seeds, one-third resprout, and one-third regenerate by both methods. The importance of different fire intensities on *Corylus cornuta* and *Rubus idaeus* were tested. *Corylus* was found to be less susceptible to intense fires than *Rubus* because of its deeper and longer underground stem. (Location: 83 H)

Key words: Fire ecology, vegetation assessment, ecology

Johnston, M.; Woodard, P. 1985. The effect of fire severity level on postfire recovery of hazel and raspberry in east-central Alberta. Can. J. Bot. 63:672-677.

This study examines the relationship between fire-severity levels and postfire plant establishment through the use of controlled burns. Results show that fire killed shrub stems at all levels of severity. Variation in fire severity had little effect on regrowth, except that lower levels tended to favor higher numbers of hazel sprouts and increased raspberry height growth. (Location: 83 H)

Key words: Fire management and effects, vegetation assessment, ecology

Johnstone, W.D.; Peterson, E.B. 1980. Above-ground component weights in Alberta *Populus* stands. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-226.

The purpose of the study was to collect information from mature and immature stands over a range of sites and a broad geographical area of Alberta, and to use the resulting data to predict the component weights of poplar trees and stands from readily measurable characteristics. From this study, equations for estimating the component weights and leaf area of aspen and balsam poplar were developed. Stand density and total standing crop showed a strong inverse relationship. (Location: 83 J, K, O)

Key words: Growth and yield, aspen, balsam poplar

Jones, G.R. 1978. The influence of clearcutting on small mammal populations in the southern boreal forest of Saskatchewan. M.Sc. thesis, Univ. Sask., Saskatoon, Saskatchewan.

The small mammal populations of cutover and adjacent forest areas are compared. *Clethrionomys gapperi* was the most common species in cutovers, and was only slightly affected by cutting. *Microtus pennsylvanicus* and *Peromyscus maniculatus* were only found in cutovers, while shrews generally preferred forest understories. (Location: 73 H)

Key words: Forest-harvesting effects, wildlife distribution and diversity, small mammals

Jozsa, L.A.; Parker, M.L.; Bramhall, P.A.; Johnson, S.G. 1984. How climate affects tree growth in the boreal forest. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-255.

White spruce annual tree-ring widths and densities from across Canada are analyzed to determine if climate has an effect on tree growth. Results suggest that temperature is more important than precipitation in influencing radial growth. (Location: Canada)

Key words: Climate and related effects, tree-crop production, white spruce

Kabzems, A. 1952. Stand dynamics and development in the mixed forest. For. Chron. 28(1):7-22.

This paper is a general discussion of stand dynamics and development in mixedwood forests. The paper's examples and conclusions relate primarily to Saskatchewan. Summary data are provided on stand-stocking and tree-volume values as well as site index curves. (Location: Saskatchewan)

Key words: Tree-crop production, ecology, growth and yield, soil and site conditions

Kabzems, A. 1971. The growth and yield of well stocked white spruce in the mixedwood section. Sask. Dep. Nat. Resour., For. Branch. Tech. Bull. 5.

The general ecology of white spruce in Saskatchewan is reviewed with information provided on the amount of forest, growth rates, and site index curves. Natural regeneration, seeding, and planting are reviewed with respect to reforestation with white spruce. (Location: Saskatchewan)

Key words: Growth and yield, economics—fiber, white spruce

Kabzems, A.; Kosowan, A.L.; Harris, W.C. 1986. Mixedwood section in an ecological perspective, Saskatchewan. 2nd ed. Sask. Parks Renewable Resour., For. Div., Prince Albert, Saskatchewan. Tech. Bull. 8.

This report describes 23 common boreal mixedwood forest types, their associated site conditions and their implications on forest management. Provincial-level data are provided on climatic conditions and the amount of various forest types that occurred within the Boreal Mixedwood zone. (Location: Saskatchewan)

Key words: Vegetation classification, soil and site conditions, economics—fiber, ecology

Kabzems, A.; Senyk, J.P. 1967. A comparison of actual and potential forest land production in Saskatchewan. For. Chron. 43:257-264.

In 1967, 34% of the Prince Albert forest area was vegetated by mixedwood and deciduous cover types, with aspen representing approximately 71 million m³ or 27% of the total volume in the area. A general synopsis is provided of

site conditions occupied by various tree species. (Location: 73 H)

Key words: Economics—fiber, tree-crop production, land evaluation, soil and site conditions

Kabzems, R.D.; Lousier, J.D. 1992. Regeneration, growth, and development of *Picea glauca* under *Populus* spp. canopy in the boreal white and black spruce zone. For. Can., Pac. Yukon Reg., Pac. For. Cent., Victoria, British Columbia, and B.C. Minist. For., Victoria, British Columbia. Can.-B.C. Partnership Agreement For., Resour. Dev. Rep. 176.

This study reviews factors that affect white spruce establishment and growth under an aspen canopy. A variety of variables are assessed, including soil temperature, moisture, and nutrient status; foliar nutrient content; rooting; and ambient temperatures. Selected reforestation considerations are also discussed. (Location: 94 J, O)

Key words: Reforestation, soil and site conditions, white spruce, aspen, vegetation control—*Calamagrostis*, juvenile stand-tending

Kagis, I. 1952. Some problems of mixedwood stands. For. Chron. 28(2):6-18.

This paper focuses on the problems associated with growth and yield estimates of both white spruce and aspen in mixedwood stands. Two broad conclusions are made by the author: that current annual increment declines prematurely in mixedwood stands relative to pure stands; and that white spruce will respond to release up to age 80 years. (Location: Saskatchewan)

Key words: Growth and yield, white spruce, aspen, uneven-aged stand management

Kansas, J.L.; Brown, W.K. 1992. Preliminary lichen habitat suitability assessment for the Little Smoky primary caribou winter range. Alberta Newsprint Company Ltd., Calgary, Alberta.

This study presents objective methods for evaluating and mapping woodland caribou habitat. In addition to collecting vascular plant cover and site data, extensive data were also collected on terrestrial and arboreal lichens. Lichens were most common in 60- and 100-year-old

lodgepole pine stands with an open to semi-open canopy. (Location: 83 K)

Key words: Vegetation assessment, wildlife-habitat assessment, soil and site conditions

- Kansas, J.L.; Raine, R.M.; Reimchen, T. 1991.** Terrain and vegetation inventory of the Notikewan South area, Alberta (1990-1991). Alta. For. Lands Wildl., Edmonton, Alberta.

A vegetation, soil, and landform inventory was conducted in a 15 000-km² area (1:100 000 scale) in northwest Alberta. For this report, the mapped area was digitized and an attribute data base summarizing the biophysical characteristics of each polygon was compiled. (Location: 84 C, D)

Key words: Vegetation assessment, soil and site conditions, physical land classification and geology

- Kelsall, J.P.; Telfer, E.S.; Wright, T.D. 1977.** The effects of fire on the ecology of the boreal forest, with particular reference to the Canadian north: a review and selected bibliography. Can. Wildl. Serv., Occas. Paper 32.

Fire is an important factor that influences the ecology of the northern boreal forests, which are fire-dependent ecosystems. This review emphasizes the impact fire has had on fish, birds, and mammals, especially game and furbearers, as well as the special characteristics of northern forests, such as permafrost. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Ecology, fire ecology, soil and site conditions, wildlife distribution and diversity, birds, small mammals, furbearers

- Kemp, G.A.; Keith, L.B. 1970.** Dynamics and regulation of red squirrel (*Tamiasciurus hudsonicus*) populations. Ecology 51:763-779.

This paper describes the population dynamics of red squirrels in mixedwood forests near Rochester, Alberta. Results show that deciduous forest areas are important to overwintering juveniles, while coniferous trees are important as food sources. (Location: 83 H)

Key words: Wildlife distribution and diversity, wildlife-habitat assessment, small mammals

- Kiil, A.D. 1970.** Effects of spring burning on vegetation in old partially cut spruce-aspen stands in east-central Alberta. Can. Dep. Fish. For., Can. For. Serv., For. Res. Lab., Edmonton, Alberta. Inf. Rep. A-X-33.

This study assesses the value of prescribed burning as a tool for regeneration of seedlings in partially cut spruce-aspen stands. The analysis focuses on the composition of postfire vegetation. Prescribed fire does not appear to be an effective tool for creating site conditions suitable for the survival of conifer seedlings in old, partially cut spruce-aspen stands, but it shows potential for hazard reduction, vegetative manipulation, and improvement of wildlife habitat. (Location: 83 I)

Key words: Fire management and effects, wildlife-habitat assessment, forest-harvesting effects

- Kimmins, J.P. 1975.** Review of the ecological effects of herbicide usage in forestry. Environ. Can., Can. For. Serv., Pac. For. Res. Cent., Victoria, British Columbia. Inf. Rep. BC-X-139.

This report is a synthesis of the biological and ecological effects of herbicides. Most of the summary is based on a bibliography compiled by Kimmins and Fraker (1973). Several areas of potential future research are identified. (Location: Canada, United States)

Key words: Vegetation control—chemical, genetics and cellular structure, ecology, vegetation assessment

- Kimmins, J.P.; Fraker, P.N. 1973.** Bibliography of herbicides in forest ecosystems. Environ. Can., Can. For. Serv., Pac. For. Res. Cent., Victoria, British Columbia. Inf. Rep. BC-X-81.

This is a bibliography of 1614 citations on herbicides used in forested ecosystems in North America up to 1973. Citations are grouped according to eight broad categories, with further subcategories. Some of the citations are annotated. (Location: Canada, United States)

Key words: Vegetation control—chemical

- Kirby, C.L. 1962.** Growth and yield of white spruce-aspen stands in Saskatchewan. Sask. Dep. Nat. Resour., For. Branch, Regina, Saskatchewan. Tech. Bull. 4.

The growth and yield of white spruce and aspen in mixedwood stands are the primary focus of this bulletin, which has information on decay, cull, and use as well as the silvics of white spruce. (Location: 73 H)

Key words: Growth and yield, white spruce, forest-damage agents, economics—fiber

- Kirby, C.L.; Bailey, W.S.; Gilmour, J.G. 1957. The growth and yield of aspen in Saskatchewan. Sask. Dep. Nat. Resour., For. Branch, Regina, Saskatchewan. Tech. Bull. 3.**

This report is a summary of studies pertaining to the growth and yield, cull, and use of aspen in Saskatchewan by the provincial forestry branch. Several tables and graphs on growth, yield, and cull are included. (Location: Saskatchewan)

Key words: Growth and yield, aspen, forest-damage agents, economics—fiber

- Kjearsgaard, A.A. 1972. Reconnaissance soil survey of the Tawatinaw map sheet (83-I). Univ. Alta., Alta. Inst. Pedol., Edmonton, Alberta. Rep. S-72-29.**

A soil survey (14 640 km²) at the series level was conducted in the Westlock to Lac La Biche area (1:126 720 scale). Profile descriptions are given for each series, and physical and chemical characteristics are summarized for selected profiles. Some vegetation-soil relationships are identified. (Location: 83 I)

Key words: Soil survey, soil and site conditions

- Knapik, L.J.; Lindsay, J.D. 1983. Reconnaissance soil survey of the Iosegun Lake area, Alberta. Alta. Res. Counc., Nat. Resour. Div., Edmonton, Alberta. Bull. 43.**

This reconnaissance soil survey (1:126 720) was conducted in the Fox Creek area (14 410 km²). The landscape was stratified according to physiography. The characteristics, distribution, and use limitations (erosion potential, tree growth) of the soils in the area are described. (Location: 83 K)

Key words: Soil survey, soil and site conditions, land evaluation, physical land classification and geology

- Knapik, L.J.; Russell, W.B.; Bessie, K.; Eng, M. 1985. Wildlife habitat district mapping and inventory prototype of the Wapiti map sheet (83L). Alta. Energy Nat. Resour., Fish Wildl. Div., Edmonton, Alberta.**

This report evaluates an approach to mapping and assessment of wildlife habitat. Land accessibility and vegetation cover are mapped. The authors recommend that landform, soils, and vegetation data be integrated before assessing wildlife habitat suitability, rather than using a monothematic map or an overlay of several monothematic maps. (Location: 83L)

Key words: Ecological land classification, wildlife-habitat assessment

- Knapik, L.J.; Russell, W.B.; Riddell, K.M.; Stevens, N. 1988. Forest ecosystem classification and land system mapping pilot project, Duck Mountain, Manitoba. Can. For. Serv., Manit. Dist. Off., Winnipeg, Manitoba, and Manit. Nat. Resour., For. Branch, Winnipeg, Manitoba. Can.-Manit. For. Renew. Agreement Rep.**

Plant communities in the Duck Mountain area were sampled for floristic composition, percentage cover, and site conditions. These data are organized into community types. Each community summary includes composition (percentage cover), soil subgroup, productivity, and successional relationships. (Location: 62 N)

Key words: Vegetation classification, soil and site conditions, ecology, soil and site productivity

- Knapik, L.J.; Westworth, D.A. 1984. Preliminary wildlife habitat regions/subregions of Alberta. Alta. Energy Nat. Resour., Fish. Wildl. Div., Edmonton, Alberta.**

Alberta was subdivided into areas with similar wildlife habitats (1:1 000 000 scale) on the basis of ecoregions and physiographic subdivisions. The primary focus in the boreal forest was on ungulates. The authors identify shortcomings of the work. (Location: Alberta)

Key words: Ecological land classification, wildlife-habitat assessment, ungulates

- Knight, H. 1967. Some limiting factors of tree growth in Alberta—a review. Can. Dep. For.**

Rural Dev., For. Branch, Calgary, Alberta.
Intern. Rep. A-8.

This review summarizes the available information on factors limiting tree growth in Alberta as they apply to the classification of forest lands. The main focus is to differentiate the limiting factors between Classes 2 and 3, and between Classes 3 and 4, of the Canada Land Inventory system. Results suggest that climate, soil moisture, and soil fertility and toxicity were the main factors limiting growth. Soil temperature is suspected as being the most important limiting factor in Alberta, but the existing literature is deemed insufficient to draw firm conclusions on such factors. (Location: Alberta)

Key words: Land evaluation, soil and site conditions, soil and site productivity, climate and related effects

Knight, H.; Duffy, P.J.B. 1967. A forest land capability classification for the Marsh Head demonstration area, Whitecourt Forest, Alberta. Can. Dep. For. Rural Dev., For. Branch, For. Res. Lab., Calgary, Alberta. Inf. Rep. A-X-10.

A 75-km² area was classified and assessed according to the Canada Land Inventory method for forestry as a demonstration study. The authors suggest more research is needed to identify site factors that limited tree growth in the area. (Location: 83 K)

Key words: Soil and site productivity, soil and site conditions

Kocaoglu, S.S. 1975. Reconnaissance soil survey of the Sand River area (73L). Univ. Alta., Alta. Inst. Pedol., Edmonton, Alberta. Rep. S-74-34.

A 1:126 720-scale soil survey was conducted in an area southeast of Lac La Biche (12 000 km²). Profile descriptions are provided for all soil series, and chemical and physical data are available for selected profiles. This soil survey is broadly stratified by landform. (Location: 73 L)

Key words: Soil survey, physical land classification and geology, soil and site conditions

Kocaoglu, S.S. 1983. Physical land classification of the Rocky-North Saskatchewan area. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. T/12-3.

This report presents a physical land classification (1:250 000) prepared for the Rocky-North Saskatchewan study area (6950 km²). It describes the area's geology, geomorphology, landforms, and soils, and includes their extent and distribution. (Location: 83 B, C, G)

Key words: Physical land classification and geology, soil and site conditions

Kocaoglu, S.S.; Bennett, K.E. 1983. An integrated resource inventory of the special Lakeland area. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. T/48.

A biophysical inventory was prepared for the special Lakeland area based on physical land classification information. The focus of the inventory is on soils, landforms, and vegetation. Included is a general description of the area, a physical land classification, and a forage classification. The purpose of the report is to provide a framework for natural-resource management. (Location: 73 E)

Key words: Physical land classification and geology, soil and site conditions, forest grazing, vegetation classification

Kocaoglu, S.S.; Sauchyn, D.J. 1980. Physical land classification of the Brazeau-Pembina study area. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. 147.

A physical land classification (1:50 000) was prepared for the Brazeau-Pembina area near Lodgepole, Alberta (3350 km²). The area was divided into physiographic regions, subregions, and geomorphic systems. A general description is given for each map unit with respect to its physical attributes. (Location: 83 B, C, G)

Key words: Physical land classification and geology, soil and site conditions

Kojima, S. 1980. Biogeoclimatic zones of southwestern Alberta. Alta. Energy Nat. Resour., Alta. For. Serv., Edmonton, Alberta.

The purpose of this investigation is to identify and delineate biogeoclimatic zones in the southwestern part of Alberta, which includes the southern portion of the Lower Boreal-Cordilleran and Boreal Mixedwood forest zones. Each biogeoclimatic zone is described in terms of the Köppen climatic classification,

climatic conditions, site conditions, and climax vegetation. (Location: Southwestern Alberta)

Key words: Ecological land classification, vegetation classification, climate and related effects, soil and site conditions

- Kolabinski, V.S. 1965.** Clearcutting alternate strips and scarifying in white spruce-aspen stands to induce white spruce regeneration, Manitoba and Saskatchewan. Can. Dep. For., For. Res. Lab., Winnipeg, Manitoba. Intern. Rep. MS-5.

The purpose of this study is to determine whether clear-cutting in strips and mechanical seedbed preparation in white spruce-aspen would result in merchantable white spruce stands. This report does not have any results, but does describe the logging procedure. *Also see* Kolabinski (1994). (Location: 62 K; 63 D; 73 H)

Key words: Vegetation control—mechanical, site preparation, white spruce

- Kolabinski, V.S. 1969a.** Location of research plots established by the Department of Fisheries and Forestry in the central region, Saskatchewan. Can. Dep. Fish. For., For. Branch, For. Res. Lab., Winnipeg, Manitoba. MS-97.

The report contains maps with the locations of various Canada Department of Fisheries and Forestry forest research plots in Saskatchewan. Twelve studies are included in the summary, seven related to deciduous or mixedwood vegetation. The study title and investigator responsible for each project are identified. (Location: Saskatchewan)

Key words: Forest-damage agents, site preparation, aspen, white spruce, juvenile stand-tending

- Kolabinski, V.S. 1969b.** Location of research plots established by the Department of Fisheries and Forestry in the Hudson Bay region, Saskatchewan. Can. Dep. Fish. For., For. Branch, For. Res. Lab., Winnipeg, Manitoba. Intern. Rep. MS-98.

This report contains maps with the locations of various Canada Department of Fisheries and Forestry forest-research plots in Saskatchewan. Five studies are included in the summary, all related to deciduous or mixedwood vegetation. The study title and the investigator responsible

for each project are identified. (Location: Saskatchewan)

Key words: Juvenile stand-tending, site preparation, aspen, white spruce

- Kolabinski, V.S. 1969c.** Location of research plots established by the Department of Fisheries and Forestry, western region, Manitoba. Can. Dep. Fish. For., For. Branch, For. Res. Lab., Winnipeg, Manitoba. Intern. Rep. MS-100.

The report contains maps with the locations of various Canada Department of Fisheries and Forestry forest-research plots in Manitoba. Fourteen studies are included in the summary, nine related to deciduous or mixedwood vegetation. The study title and investigator responsible for each project are identified. (Location: Manitoba)

Key words: Forest-damage agents, juvenile stand-tending, site preparation, uneven-aged stand management, reforestation, aspen, white spruce

- Kolabinski, V.S. 1994.** Clear cutting alternate strips and scarifying in white spruce and white spruce-trembling aspen stands to induce natural white spruce regeneration, Manitoba and Saskatchewan. Nat. Resour. Can., Can. For. Serv., Man. Dist. Off., Winnipeg, Manitoba, and Man. Nat. Resour., For. Branch, Winnipeg, Manitoba. Can.-Manit. Partnership Agreement For. Rep.

This study evaluates the effectiveness of scarifying linear cutover areas to encourage natural white spruce regeneration. The sites were cut in the early 1960s. It was found that blading was more effective than fire-line plowing, which produced furrows that were too deep and did not cover a sufficient amount of area. White spruce regeneration varied according to the moisture regime and severity of the preparation. (Location: 73 H; 63 D, E; 62 N)

Key words: Site preparation, white spruce, soil and site conditions, reforestation

- Krämer, A. 1971.** A review of the ecological relationships between mule and white-tailed deer. Alta. Dep. Lands For., Fish Wildl. Div., Edmonton, Alberta. Occas. Pap. 3.

The interactions of mule deer and white-tailed deer are reviewed. The author concludes that climatic conditions such as winter severity and drought are more restrictive to the distribution of white-tailed deer than mule deer. This paper also concludes that competition between the species was minimal, due to somewhat different habitat requirements. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Wildlife distribution and diversity, wildlife-habitat assessment, ungulates

Krause, H.H.; Weetman, G.F.; Koller, E.; Veilleuz, J.M. 1982. Interprovincial forest fertilization program—five year growth remeasurements. Environ. Can., Can. For. Serv., Ottawa, Ontario. Inf. Rep. DPC-X-12.

For this study, forest plots across Canada were fertilized to determine the effects on growth. Only one boreal mixedwood/aspen plot was included in the analysis. Fertilization with nitrogen plus phosphorus resulted in no response, but a large growth response was obtained with nitrogen plus potassium, and nitrogen with phosphorus plus potassium. (Location: Saskatchewan)

Key words: Soil and site conditions, growth and yield, soil and site productivity

Krumlik, G.J.; Johnson, J.D.; Lemmen, L.D. 1978. Biogeoclimatic ecosystem classification of Alberta, forest types in northwestern Alberta—first approximation. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta.

Fourteen forest types in four biogeoclimatic zones are recognized and characterized with respect to species composition and site conditions. Two forest types are mixedwood-related. Site index and mean annual increment values are provided for various tree species within each recognized vegetation type. (Location: Northwestern Alberta)

Key words: Vegetation classification, soil and site conditions, growth and yield

Krumlik, G.J.; Slaco, R.; Nichols, J.S. 1982. A classification and interpretation of forest ecosystems of the eastern half of the Berland forest management area, Alberta—a first

approximation. Prepared for British Columbia Forest Products Ltd.

This study classifies and interprets forest ecosystems within the eastern half of the Berland Forest Management Area. The study includes vegetation sampling and site interpretations. The biogeoclimatic approach is used for the classification. Site index values are provided for various tree species within each recognized vegetation type. (Location: 83 F)

Key words: Vegetation classification, soil and site conditions, growth and yield

Kumar, P. 1973a. Biophysical analysis and evaluation of capability: Fawcett-Moose Portage area. Alta. Lands For., Land Use Assignment Branch, Edmonton, Alberta.

A biophysical land classification (1:126 720 scale) was developed for an area located between Slave Lake and Athabasca, based primarily on soils and surficial materials. Canada Land Inventory equivalent ratings were developed for agriculture, forestry, recreation, ungulate, and waterfowl. (Location: 83 I, J, O, P)

Key words: Ecological land classification, land evaluation

Kumar, P. 1973b. Biophysical analysis and evaluation of capability: Rochester area. Alta. Lands For., Land Use Assignment Comm., Edmonton, Alberta.

A biophysical classification (1:126 720) was prepared for the Rochester area. Each ecosection (Land System) is described in terms of physiography, soil associations, present use, and natural cover. Suitability ratings are provided for agriculture, forestry, ungulates, recreation, and waterfowl. (Location: 83 I, J)

Key words: Ecological land classification, land evaluation

Kumar, P. 1975. Biophysical analysis and evaluation of capability: Snipe Lake area. Alta. Lands For., Land Use Assignment Branch, Edmonton, Alberta.

A biophysical classification (1:126 720) was prepared for the Snipe Lake area. Each ecosection (Land System) is described in terms of physiography, soil associations, present use,

and natural cover. Suitability ratings are provided for agriculture, forestry, ungulates, recreation, and waterfowl. (Location: 83 N)

Key words: Ecological land classification, land evaluation

- Kumar, P. 1977. Biophysical analysis and evaluation of capability: High Level. Alta. Energy Nat. Resour., Land Use Assignment Comm., Edmonton, Alberta.**

A biophysical classification (1:126 720) was developed in the High Level area (3200 km²). The resources, mostly physical attributes, of each mapped ecosection are described. The capability of each ecosection is rated for agriculture, forestry, recreation, ungulates, and waterfowl. (Location: 84 J, K)

Key words: Ecological land classification, land evaluation

- Kurz, W.A.; Apps, M.J. 1993. Contribution of northern forests to the global C cycle: Canada as a case study. Water Air Soil Pollut. 70:163-176.**

The authors of this paper argue that human interference in the boreal forest since 1920 has resulted in increasingly older forests due to control of disturbances such as fire. With increasing age, forests accumulate greater amounts of total carbon. The authors maintain, however, that continued aging of stands could result in reduced rates of carbon uptake, which could contribute to global warming. (Location: Canada)

Key words: Climate and related effects, pollution effects

- Kurz, W.A.; Apps, M.J. 1994. The carbon budget of Canadian forests: a sensitivity analysis of changes in disturbance regimes, growth rates, and decomposition rates. Environ. Pollut. 83:55-61.**

This paper presents the results of a computer-modeling exercise. Climatic warming was predicted to result in an increased accumulation of carbon in the environment. Also considered are the effects of warming on tree growth, decomposition, and disturbance rates. (Location: Canada)

Key words: Climate and related effects, pollution effects

- Kurz, W.A.; Apps, M.J. 1995. An analysis of future carbon budgets of Canadian boreal forests. Water Air Soil Pollut. 82:321-331.**

Six different boreal forest management scenarios are assessed to evaluate their potential effects on the boreal forest carbon budget. The scenarios include different fire, planting, and conversion regimes. In general, scenarios with fewer fires, increased planting of disturbances, and nonstocked areas tended to increase the amount of carbon taken up by the system. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Climatic and related effects, forest-harvesting effects, fire management and effects, pollution effects

- Kurz, W.A.; Apps, M.J.; Beukema, S.J.; Lekstrum, T. 1995. 20th century carbon budget of Canadian forests. Tellus 47B:170-177.**

The authors argue that the boreal forest is a carbon sink. Their conclusions are based on computer modeling of forest growth, disturbance regimes, and organic matter dynamics for the period between 1920 and 1989. The accumulation rate for this period is estimated at 0.2 Gt C/yr. It was found that the boreal forest was subjected to less disturbance during the study period than previously, and, as a result, average stand ages have become older. (Location: Canada)

Key words: Climate and related effects, pollution effects

- Kurz, W.A.; Apps, M.J.; Stocks, B.J.; Volney, W.J.A. 1995. Global climate change: disturbance regimes and biospheric feedbacks of temperate and boreal forests. Pages 119-133 in G.M. Woodwell and F.T. Mackenzie, eds. Biotic feedbacks in the global change system: will the warming feed the warming? Oxford Univ. Press, New York, New York.**

Potential response factors to global climatic change are discussed, as well as how these factors could adjust themselves to changes. Climate change could result in delayed natural regeneration, different carbon accumulation rates, and different fire and forest pest regimes.

The authors suggest that the loss of southern forests might not be fully replaced by corresponding changes farther north. (Location: Canada)

Key words: Pollution effects, climate and related effects, forest-damage agents, fire ecology

Kusch, D.S.; Cerezke, H.F. 1991a. Aphids. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 11.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of aphids. (Location: Canada)

Key words: Forest-damage agents, pest control

Kusch, D.S.; Cerezke, H.F. 1991b. Yellow-headed spruce sawfly. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 7.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of yellow-headed spruce sawfly. (Location: Canada)

Key words: Forest-damage agents, white spruce, pest control

Kusch, D.S.; Langor, D.W. 1992. Pine needle scale. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 16.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of pine needle scale. (Location: Canada)

Key words: Forest-damage agents, pest control

Lacate, D.S.; Horton, K.W.; Blyth, A.W. 1965. Forest conditions on the lower Peace River. Can. Dep. For., For. Res. Branch, Ottawa, Ontario. Publ. 1094.

A reconnaissance survey was conducted along the Peace River in Wood Buffalo National Park to evaluate forest productivity and ecological conditions. This survey examines terrain, forest and understory vegetation, and soil and site conditions, primarily on river terraces. (Location: 84 I, P)

Key words: Physical land classification and geology, growth and yield, soil and site

conditions, vegetation assessment, ecology, fire ecology, white spruce

Laidlaw, T.F. 1974. The potential of trembling aspen for reclamation planting in Alberta: some techniques of propagation. Pages 88-92 in D. Hocking and W.R. MacDonald, eds. A Workshop on Reclamation of Disturbed Lands in Alberta. Proc., March 27-28, 1974, Edmonton, Alberta. Alta. Environ. and Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-116.

The author argues for and identifies techniques for using trembling aspen for reclamation planting in Alberta. Some of these techniques are potentially useful in reforestation with respect to seed collection, preparation, storage, germination, and growth. (Location: Alberta)

Key words: Aspen, ecology, reforestation, plant propagation, reclamation

Laird, M.L. 1987. Forest management and herbicides. Alta. Environ., Waste Chem. Div., Pestic. Manage. Branch, Edmonton, Alberta.

Literature on various techniques (e.g., mechanical, chemical, burning, and biological) for controlling vegetation that competes with juvenile conifers is reviewed and evaluated with respect to their advantages and problems. A questionnaire was used to solicit opinions on the various techniques from 15 public agencies, private companies, and special-interest groups. (Location: Not applicable; literature review)

Key words: Vegetation control—mechanical, vegetation control—chemical, fire management and effects

Lakusta, T. 1988. Regeneration performance zones of Alberta: climate analysis component. Alta. For. Lands Wildl., Land Inf. Branch, Edmonton, Alberta.

A climatic analysis of Alberta's forested area based on 194 stations was conducted to determine which climatic variables differentiated the various forest zones. Results indicate that a complex of variables related to growing-degree days and moisture deficits provide the clearest differentiation between climatic zones. (Location: Alberta)

Key words: Climate and related effects, reforestation

- Landhausser, S.M.; Lieffers, V.J. 1994. Competition between *Calamagrostis canadensis* and *Epilobium angustifolium* under different soil temperature and nutrient regimes. Can. J. For. Res. 24:2244–2250.

Laboratory experiments found that marsh reed grass (*Calamagrostis canadensis*) is a more successful competitor on warmer (21°C) and nutrient rich soils than fireweed (*Epilobium angustifolium*). Reduced levels of competition and poorer growth occurred among the species at lower experimental temperatures (9°C) and in soil with poor nutrient regimes. Vegetative reproduction was greater for fireweed than marsh reed grass on cooler soils, allowing fireweed to have a more dominant role in colonizing disturbed sites as well as suppressing invasion by marsh reed grass. (Location: Not applicable; laboratory study)

Key words: Site preparation, vegetation control—*Calamagrostis*, ecology, vegetation assessment

- Landhausser, S.M.; Lieffers, V.J. 1997. Seasonal changes in carbohydrate storage and regrowth in applications in *Picea glauca* understory regeneration. Scand. J. For. Res. 12:27–32.

This study tested beaked hazel (*Corylus cornuta*), wild rose (*Rosa acicularis*), mooseberry (*Viburnum edule*), red-osier dogwood (*Cornus stolonifera*), and fireweed (*Epilobium angustifolium*) sprouting from rhizome cuttings. Sprouting was greatest when cuttings were taken in late summer as opposed to early summer, when carbohydrate reserves were greatest. The length of the rhizome had no effect on sprouting. (Location: 73 L)

Key words: Vegetation control—mechanical, forest-harvesting effects

- Landhausser, S.M.; Stadt, K.J.; Lieffers, V.J.; McNabb, D.H. 1996. Rhizome growth of *Calamagrostis canadensis* in response to soil nutrient and bulk density. Can. J. Plant Sci. 76:545–550.

Calamagrostis produced three times more root in low-density soil than high-density soil, based on length, although total biomass was

similar. Rhizome internode lengths were greater in duff than mineral soil horizons. Once established, nutrient availability limited above- and below-ground development of the plant. (Location: Not applicable; laboratory study)

Key word: Soil and site conditions, vegetation control—*Calamagrostis*

- Langor, D.W. 1995. Satin moth. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 35.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of satin moths. (Location: Canada)

Key words: Forest-damage agents, pest control

- Langor, D.W.; Drouin, J.A.; Wong, H.R. 1992. The lodgepole pine terminal weevil in the prairie provinces. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Manage. Note 55.

This paper summarizes the distribution, life history, and factors affecting the mortality of lodgepole pine terminal weevil populations. This pest was studied in both lodgepole and jack pine stands. In addition, the effects of silvicultural conditions, pruning, biological controls, and insecticides are reviewed. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Invertebrates, pest control, forest-damage agents

- Langor, D.; Spence, J.; Niemelä, J.; Cárcamo, H. 1994. Insect biodiversity studies in the boreal forests of Alberta, Canada. Metsäntutkimuslaitoksen Tied. 482:25–31.

The authors of this paper advocate the use of pre- and postharvesting ground-beetle surveys as a method for assessing environmental effects. Clear-cutting is thought to result in an increased diversity of invertebrates, but the removal of residual stands before the cut stand areas were adequately repopulated could result in severe impacts to species associated with older stands. (Location: Not specified)

Key words: Ecology, invertebrates

La Roi, G.H. 1992. Classification and ordination of southern boreal forests from the Hondo-Slave Lake area of central Alberta. *Can. J. Bot.* 70:614-628.

Six boreal-forest plant communities are recognized using TWINSpan, with two communities being mixedwood types. Ordinations are presented of vegetation plots and understory species groups. Ordinated plots are also stratified according to moisture regimes and general soil texture classes. (Location: 83 O)

Key words: Vegetation classification, soil and site conditions

La Roi, G.H.; Ellis, R.A. 1984. The flora and vegetation around fire lookout towers and their access roads in western Alberta. *Univ. Alta., Dep. Bot., Edmonton, Alberta.*

Disturbed and native plant communities around fire towers in western Alberta are described. These descriptions included cover estimates by species and species height data. Only two of the study sites (White Mountain and Clear Hills) occurred in mixedwood vegetation. (Location: Western Alberta)

Key words: Vegetation classification, environmental impacts, vegetation assessment

La Roi, G.H.; Ostafichuk, M. 1982. Structural dynamics of boreal forest ecosystems on three habitat types in the Hondo-Lesser Slave Lake area of north central Alberta in 1981. *Alta. Environ., Res. Manage. Div., Edmonton, Alberta.*

The composition and structure of eight forest plant communities are described as background information for a long-term study of boreal-forest plant community near Hondo, Alberta. Two of the communities were mixedwood stands. Data are given on plant phenology. (Location: 83 O)

Key words: Vegetation assessment, ecology

Leblanc, J.-D.; Sutherland, B.J. 1987. Comparative evaluation of seven site preparation tools in a residual poplar mixedwood stand in Saskatchewan. *Can. For. Serv., Great Lakes For. Cent., Sault Ste. Marie, Ontario. Inf. Rep. O-X-381.*

This paper reports on a comparative testing of mechanized scarification tools in residual poplar mixedwood stands in Saskatchewan. The objective of the scarification was to create plantable microsites for conifers. It is recommended that light, skidder-drawn equipment should be used in low-density residual poplar stands. In high-density residual stands, front-mounted v-blades or plows are recommended. (Location: Saskatchewan)

Key words: Site preparation, vegetation control—mechanical, reforestation

Lee, P.C.; Crites, S.; Nietfeld, M.; Van Nguyen, H.; Stelfox, J.B. 1995. Changes in snags and down woody material characteristics in a chronosequence in aspen mixedwood forests in Alberta. Pages 49-61 in J.B. Stelfox, ed. Relationship between stand age, stand structure, and biodiversity in aspen mixedwood forests in Alberta. *Alta. Environ. Cent., Vegreville, Alberta, Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Alta. Land For. Serv., Edmonton, Alberta.*

Standing dead trees and downed woody material are compared in three age groups of 12 aspen stands ranging from 23 to 146 years old. In younger stands, snags primarily originated from prefire materials, but as stands aged, a larger proportion was derived from postfire trees. The total quantity of snags and woody debris increased with stand age. (Location: 73 L; 83 P)

Key words: Vegetation assessment, ecology, aspen

Lee, P.C.; Crites, S.; Stelfox, J.B. 1995. Changes in forest structure and floral composition in a chronosequence of aspen mixedwood stands in Alberta. Pages 29-48 in J.B. Stelfox, ed. Relationship between stand age, stand structure, and biodiversity in aspen mixedwood forests in Alberta. *Alta. Environ. Cent., Vegreville, Alberta, Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ., Alta. Land For. Serv., Edmonton, Alberta.*

This study compares stand and structural characteristics to determine how younger aspen stands differ from older stands (12 stands from 23 to 146 years old). Results indicate that older stands tend to have a lower density of

trees, a structurally and compositionally enhanced understory, a greater abundance of deadwood, the development of secondary canopy species, and a nonvascular vegetation cover developed on downed woody material. (Location: 73 L; 83 P)

Key words: Vegetation assessment, ecology, aspen

- Lee, P.C.; Crites, S.; Sturgess, K.; Stelfox, J.B. 1995. Changes in understory composition for a chronosequence of aspen mixedwood stands in Alberta. Pages 63–90 in J.B. Stelfox, ed. Relationship between stand age, stand structure, and biodiversity in aspen mixedwood forests in Alberta. Alta. Environ. Cent., Vegreville, Alberta, Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta Environ., Alta. Land For. Serv., Edmonton, Alberta.

This study evaluates changes in the understory vegetation composition of aspen stands based on three age categories (72 stands from 23 to 146 years old). The authors conclude that changes in understory species composition with time were primarily due to shifts in abundance among groups of common species. This conclusion is based on the fact that 85% of the species in young stands were also found in older stands (Location: 73 L; 83 P)

Key words: Vegetation classification, vegetation assessment, ecology, aspen

- Lees, J.C. 1960. The application of silvicultural systems to the B.19 foothills region of Alberta. M.F. thesis, Univ. B.C., Vancouver, British Columbia.

Not available for review. (Location: Alberta)

Key words: Silviculture, even-aged stand management, uneven-aged stand management

- Lees, J.C. 1962a. Alberta foothills silviculture. *For. Chron.* 38:173–181.

Various harvesting and site-treatment systems (clear-cutting, shelterwood, and selective cutting) applied in the Lower Boreal–Cordilleran ecoregion are reviewed. Silvicultural systems are stratified according to moisture regime and forest cover type to optimize successful reforestation results. (Location: 83 K)

Key words: Soil and site conditions, forest-harvesting effects, silviculture

- Lees, J.C. 1962b. A discussion on white spruce natural regeneration in Alberta's spruce/aspen stands. *Empire For. Rev.* 41:214–219.

The merits of a two-cut uniform shelterwood system are discussed. Advantages include protection of the site from atmospheric elements, a local seed source, increased insolation, sheltering of seedlings, a maintenance of mineral seed beds for approximately 5 years, minimization of competition from some understory species, and better growth. (Location: Alberta)

Key words: Uneven-aged stand management, forest-harvesting effects, reforestation, white spruce

- Lees, J.C. 1963. Partial cutting with scarification in Alberta spruce–aspen stands. *Can. Dep. For., For. Res. Branch, Ottawa, Ontario. Publ.* 1001.

This study was conducted in 110-year-old aspen–spruce stands to evaluate scarification at different levels of intensity as a site-preparation technique for white spruce regeneration. Results indicate that only the scarified seedbed permitted satisfactory establishment of spruce. It was noted that aspen growth was poor because many trees were overmature and decadent. (Location: 83 O)

Key words: Site preparation, white spruce, reforestation, uneven-aged stand management

- Lees, J.C. 1964. A test of harvest cutting methods in Alberta's spruce–aspen forest. *Can. Dep. For., For. Res. Branch, Ottawa, Ontario. Publ.* 1042.

Eight harvesting methods are investigated to determine which methods promoted maximum yield and satisfactory regeneration in spruce–aspen stands. The methods that promoted better stand growth rates, lowest mortality, and best regeneration were the selective-cutting method or a two-cut shelterwood system. (Location: 83 O)

Key words: Tree-crop production, reforestation, uneven-aged stand management

Lees, J.C. 1965. Assessment of operational scarification in the spruce-aspen forest of Alberta. Can. Dep. For., For. Res. Lab., Calgary, Alberta. Intern. Rep. A-2.

The effectiveness of various equipment for scarification in spruce-aspen stands is discussed, based on work at seven different sites. Results indicate that scarification equipment exposes adequate mineral soil, providing a good seedbed for seedling survival. The main problem encountered was an excessive accumulation of leaf litter and vegetation encroachment. (Location: 83 L, O, P)

Key words: Site preparation, vegetation control—mechanical, reforestation

Lees, J.C. 1966. Release of white spruce from aspen competition in Alberta's spruce-aspen forest. Can. Dep. For., For. Res. Branch, Ottawa, Ontario. Publ. 1163.

Aspen removal in mixedwood stands resulted in increased height growth rates and a 20–40% increase in merchantable volume of white spruce. Twenty-five stands were included in the test on a variety of site types. Treatment of aspen with ammonium sulfamate minimized sucker regrowth for several years. (Location: Alberta)

Key words: Uneven-aged stand management, vegetation control—chemical, growth and yield, white spruce

Lees, J.C. 1970a. Natural regeneration of white spruce under spruce-aspen shelterwood, B-18a forest section, Alberta. Can. Dep. Fish. For., Can. For. Serv., Ottawa, Ontario. Publ. 1274.

This study reports observations of white spruce regeneration following scarification under a spruce-aspen shelterwood in the Slave Lake forest. Three site groups were sampled: dry upland, moist transition, and wet bottomland. Results from the study suggest that shelterwood cutting and scarification provide the necessary regime for successful natural regeneration of white spruce. Vegetative competition affected seedling height growth on all sites. Mineral soil was the most productive seedbed on scarified areas, and rotten wood on undisturbed areas. (Location: 83 O)

Key words: Uneven-aged stand management, site preparation, forest-harvesting effects, white spruce

Lees, J.C. 1970b. A test of silvicultural practices designed to secure reproduction in partially cut mixedwood stands in Alberta. Can. Dep. Fish. For., Can. For. Serv., For. Res. Lab., Edmonton, Alberta. Intern. Rep. A-31.

The purpose of this project was to obtain adequate white spruce regeneration by the combined use of shelterwood cutting, scarification, aspen control, and broadcast seeding on three major sites: dry upland, moist transition, and wet bottomland. (Location: 83 O)

Key words: Site preparation, reforestation, soil and site conditions, forest-harvesting effects

Lehn, G. 1980. Aspen biomass productivity—genotype versus phenotype. Page 131 in B.P. Dancik and K.O. Higginbotham, eds. Proc. Sixth North Am. For. Biol. Workshop., August 11–13, 1980, Edmonton, Alberta. Soc. Am. For., Bethesda, Maryland.

The effects of site and genetic control over biomass production are briefly discussed in this abstract. Inter- and intracolonial variation in biomass of the sound merchantable portion of the bole were used to gauge heritability. (Location: 83 C, J)

Key words: Genetics and cellular structure, soil and site conditions, aspen

Lehn, G.A. 1979. Natural variation in merchantable stem biomass among clones of trembling aspen. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

The stocking, clone-size variation, and inter- and intracolonial variation of aspen stands were examined. Clonal size varied up to tenfold, which is thought to be a function of stand history rather than environmental conditions. Good aspen sites were found to be 6.5 times more productive than poor sites. A large amount of variation was observed among clones. (Location: 83 C, J)

Key words: Growth and yield, tree-crop production, aspen

Lehn, G.A.; Higginbotham, K.O. 1982. Natural variation in merchantable stem biomass and volume among clones of *Populus tremuloides* Michx. Can. J. For. Res. 12:83-89.

Various traits of aspen are examined and related to potentially merchantable biomass and volume production, and probable management strategies. The relative effects of site and genetic control on production are also examined. Results show that there is a large amount of clonal variability in biomass production. If the best clones are selected, biomass at 85 years could be increased by 16%. The results suggest that approximately one-third of the variation in biomass and volume is genetically based. (Location: 83 C, J)

Key words: Growth and yield, soil and site conditions, genetics and cellular structure, aspen

Leskiw, L.; Dowgray, J.; Ealey, D.; McCourt, K. 1984. Wildlife habitat districts and land surface disturbance, Rocky Mountain House—83B. Alta. Energy Nat. Resour., Fish Wildl. Div., Edmonton, Alberta.

A wildlife-habitat district map based on ecological land classification and soils survey information, and a land surface disturbance map, were developed at a scale of 1:250 000 for the Rocky Mountain House area. (Location: 83 B)

Key words: Ecological land classification, wildlife-habitat assessment, environmental impacts, ungulates, furbearers, birds

Lesko, G.L.; Lindsay, J.D. 1973. Forest/soil relationships and management considerations in a portion of the Chip Lake map area, Alberta. Res. Coun. Alta., Edmonton, Alberta. Rep. 73-1.

The purpose of this study is to determine forest/soil relationships for the Chip Lake study area. Results indicate that site index was more useful than basal area for predicting forest productivity. Soil drainage is identified as the most important soil property influencing tree growth in the study area. (Location: 83 G)

Key words: Vegetation assessment, soil and site conditions, soil and site productivity, growth and yield

Lewis, H.T. 1977. Maskuta: the ecology of Indians first in northern Alberta. West. Can. J. Anthropol. 7:15-52.

Based on interviews with more than 50 older Aboriginal people from across Alberta's boreal forest region, information was obtained on the types of microenvironments once burned, the reasons for burning, and considerations in controlling human-made fires. From these interviews, it appears that northern Alberta Aboriginals used very sophisticated approaches to, and had an understanding of, the dynamics of fire for management of plant and animal resources. (Location: Alberta)

Key words: Fire management and effects, ecology

L'Hirondelle, S.J.; Addison, P.A.; Huebert, D.B. 1986. Growth and physiological responses of aspen and jack pine to intermittent SO₂ fumigation episodes. Can. J. Bot. 64:2421-2427.

This study suggests that low frequencies of high sulfur dioxide exposure did not decrease aspen biomass production. Laboratory experiments found that aspen physiological processes recovered fully within 21 hours after exposure. Jack pine, however, was negatively affected more than aspen by exposure to sulfur dioxide. (Location: 74 D, E)

Key words: Pollution effects, aspen, jack pine

Lieffers, V.J. 1995. Ecology and dynamics of boreal understory species and their role in partial-cut silviculture. Pages 33-39 in C.R. Bamsey, ed. Proc. Innovative Silv. Syst. Boreal For. Symp., October 2-8, 1994, Edmonton, Alberta. Clear Lake Ltd., Edmonton, Alberta.

Various factors that affect the composition and abundance of understory plants such as stand history, successional stage, light quality, phenology, and shade tolerance are reviewed. The author defines three types of understory plants, based primarily on light quality and quantity: Avoider, Obligate, and Tolerator species. (Location: Not specified)

Key words: Ecology, forest-harvesting effects, climate and related effects

Lieffers, V.J.; Campbell, J.S. 1984. Biomass and growth of *Populus tremuloides* in

northeastern Alberta: estimates using hierarchy in tree size. *Can. J. For. Res.* 14:610–616.

This study determines the total biomass and growth of aspen in a number of aspen stands within the Fort McMurray area of northeastern Alberta. The main objectives are to relate biomass and growth to tree density, age, and air pollution from oil-sands mining and refinery operations. Stands ranged from 23 to 57 years old, aboveground biomass ranged from 37 to 156 t/ha, and rates of production ranged from 1.5 to 5.2 t/ha per year. There was no detectable reduction in growth near the sulfur dioxide source. (Location: 74 D, E)

Key words: Tree-crop production, pollution effects, aspen

Lieffers, V.J.; Macdonald, S.E.; Hogg, E.H. 1993. Ecology of and control strategy for *Calamagrostis canadensis* in boreal forest sites. *Can. J. For. Res.* 23:2070–2077.

This study reviews various strategies to control *Calamagrostis canadensis* in deciduous cutovers, including fire, herbicide, mechanical and chemical treatments; minimized disturbance of the forest floor; and development of a dense overstory. Information is also provided on the ecology of the species. (Location: Not applicable; literature review)

Key words: Vegetation control—*Calamagrostis*, vegetation control—chemical, vegetation control—mechanical, fire management and effects, ecology

Lieffers, V.J.; Macmillan, R.E.; MacPherson, D.; Branter, K.; Stewart, J.D. 1996. Semi-natural and intensive silvicultural systems for the boreal mixedwood forest. *For. Chron.* 72:286–292.

The effects of various harvesting systems on mixedwood forest types are reviewed to assess the anticipated response in structure and composition. In general, clear-cutting alone often results in a monoculture of aspen, whereas clear-cutting or partial cutting in combination with understory protection, planting, and uneven-aged stand management produces stands with a varied structure and composition. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-harvesting effects, even-aged stand management, uneven-aged stand management, silviculture

Lieffers, V.J.; Stadt, K.J. 1994. Growth of understory *Picea glauca*, *Calamagrostis canadensis* and *Epilobium angustifolium* in relation to overstory light. *Can. J. For. Res.* 24:1193–1198.

This study assesses the impact of light transmitted through mixed aspen–white spruce stands on the abundance of fireweed (*Epilobium angustifolium*) and marsh reedgrass (*Calamagrostis canadensis*). The study concludes that marsh reedgrass cover and height decreases with decreased light levels, although only 15% light transmission was necessary for 100% frequency in 1-m² plots. The relationship between light levels and fireweed was weak, and its cover was reduced to zero when light transmission was less than 10%. At similar light levels, average white spruce growth increment was 5 cm, but increased to 25 cm at 40% of maximum. (Location: 83 J)

Key words: Ecology, vegetation control—*Calamagrostis*, climate and related effects, vegetation assessment, white spruce

Lieffers, V.J.; Stadt, K.J.; Navratil, S. 1996. Age structure and growth of understory white spruce under aspen. *Can. J. For. Res.* 26:1002–1007.

This paper discusses white spruce (*Picea glauca*) recruitment, and finds that it occurs immediately after disturbance and during subsequent years of stand development. A third of all spruce seedlings were found to be established on rotten logs, although rotten logs represented only 5% of the ground surface. White spruce seedlings established during the early years of stand development tended to have greater height and diameter growth than those established in latter years at equivalent ages. It was also found that the length of annual height increments increased as seedlings increased in height. (Location: 83 J)

Key words: Uneven-aged stand management, reforestation, growth and yield

Lindsay, J.D.; Heringa, P.K.; Pawluk, S.; Odynsky, W. 1957. Exploratory soil survey of Alberta map sheets 84-C (east half), 84-B, 84-A, and

74-D. Res. Counc. Alta., Edmonton, Alberta. Prelim. Soil Surv. Rep. 58-1.

A general survey of soils and parent materials was conducted over a large area. Sampling intensity was very low. Very general soil profile descriptions are given along with several sets of chemical and physical analyses. (Location: 84 A, B, C; 74 D)

Key words: Soil survey, soil and site conditions

Lindsay, J.D.; Odyinsky, W.; Peters, T.W.; Bowser, W.E. 1968. Soil survey of the Buck Lake (NE83B) and Wabamun Lake (E1/2 83G) areas. Univ. Alta., Edmonton, Alberta. Alta. Soil Surv. Rep. 24.

In this paper soils are classified to the series level and mapped at a scale of 1:126 720 for a 4222-km² area. General profile descriptions are provided for each series, and chemical and physical attributes are included for selected profiles. The subgroup classification needs updating. (Location: 83 B, G)

Key words: Soil survey, soil and site conditions

Lindsay, J.D.; Pawluk, S.; Odyinsky, W. 1958. Exploratory soil survey of Alberta map sheets 84-D (north half), 84-E, 84-F, and 84-G. Res. Counc. Alta., Edmonton, Alberta. Prelim. Soil Surv. Rep. 59-1.

A general survey of soils and parent materials was conducted over a large area. Sampling intensity was very low. Very general soil profile descriptions are given along with several sets of chemical and physical analyses. (Location: 84 D, E, F, G)

Key words: Soil survey, soil and site conditions

Lindsay, J.D.; Pawluk, S.; Odyinsky, W. 1959. Exploratory soil survey of Alberta map sheets 84-J, 84-K, and 84-L. Res. Counc. Alta., Edmonton, Alberta. Prelim. Soil Surv. Rep. 60-1.

A general survey of soils and parent materials was conducted over a large area. Sampling intensity was very low. Very general soil profile descriptions are given along with several sets of chemical and physical analyses. (Location: 84 J, K, L)

Key words: Soil survey, soil and site conditions

Lindsay, J.D.; Pawluk S.; Odyinsky, W. 1960. Exploratory soil survey of Alberta map sheets 84-M, 84-N, and 84-O. Res. Counc. Alta., Edmonton, Alberta. Prelim. Soil Surv. Rep. 61-1.

A general survey of soils and parent materials was conducted over a large area. Sampling intensity was very low. Very general soil profile descriptions are given along with several sets of chemical and physical analyses. (Location: 84 M, N, O)

Key words: Soil survey, soil and site conditions

Lindsay, J.D.; Pawluk, S.; Odyinsky, W. 1961. Exploratory soil survey of Alberta map sheet 84-P, 84-I, and 84-H. Res. Counc. Alta., Edmonton, Alberta. Prelim. Soil Surv. Rep. 62-1.

A general survey of soils and parent materials was conducted over a large area. Sampling intensity was very low. Very general soil profile descriptions are given along with several sets of chemical and physical analyses. (Location: 84 H, I, P)

Key words: Soil survey, soil and site conditions

Loman and Associates. 1976. The distribution of vanadium in foliage of four indicator tree species and in two types of litter within a seven mile radius from the Great Canadian Oil Sands Ltd. complex. Great Canadian Oil Sands Ltd., Calgary, Alberta.

Not available for review. (Location: 74 E)

Key words: Pollution effects, soil and site conditions

Loman, A.A.; Blauel, R.A.; Hocking, D. 1972. Sulfur dioxide and forest vegetation. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-49.

This study distinguishes between controllable and uncontrollable factors that cause sulfur dioxide damage in forest vegetation. In general, an inverse relationship exists between the rate of plant metabolism and sulfur dioxide tolerance levels. Results of this study indicate that one part per million of sulfur dioxide will injure forest species at less than 1 hour of exposure. At lower levels of exposure, only sensitive

plants such as lichens and bryophytes will be damaged. (Location: Alberta)

Key words: Pollution effects, vegetation assessment

- Loseth, P.; Dye, D.; Sutton, B. 1990.** Site index estimation from environmental factors in Saskatchewan. For. Can., Sask. Dist. Off., Prince Albert, Saskatchewan, and Sask. Dep. Parks Renew. Resour., For. Branch, Prince Albert, Saskatchewan. Can.-Sask. For. Resour. Dev. Agreement Rep.

This study predicts site index from site parameters based on regression-analysis techniques. Factors such as drainage, soil texture, location, and solar radiation are included in the models. Most of the analysis is oriented toward conifers, but also includes aspen. (Location: Saskatchewan)

Key words: Growth and yield, soil and site conditions, white spruce, black spruce, jack pine, aspen

- Luck, S. 1982.** Bear-Wapiti sand dunes: level I resource inventory and assessment. Alta. Rec. Parks, Edmonton, Alberta.

The report presents a resource inventory and assessment of an area located southeast of Grande Prairie (77 km²). Broadly defined plant communities are described. Recommendations to protect the area include the establishment of a low-use park. (Location: 83 M)

Key words: Physical land classification and geology, vegetation assessment, vegetation classification, land evaluation

- MacCallum, B.; Ebel, G.R.A. 1984.** Ecological considerations for the wildlife of the Champion forest management area, Alberta. Alta. Energy Nat. Resour., Fish Wildl. Div., Edmonton, Alberta.

A faunal list of 275 species was developed for the St. Regis Forest Management Area. Each species was assigned to a habitat and successional stage, and assessed for its versatility with respect to habitat use for reproduction and feeding. (Location: 83 F)

Key words: Wildlife distribution and diversity, wildlife-habitat assessment, ungulates, fur-bearers, small mammals, birds, amphibians

- MacDonald, G.B. 1996.** Mixedwood management research and practices in Ontario. Pages 102-113 in P.G. Comeau and K.D. Thomas, eds. Silviculture of temperate and boreal broadleaf-conifer mixtures. Proc. Symp., February 28-March 1, 1995, Richmond, British Columbia. B.C. Minist. For., Victoria, British Columbia. Land Manage. Handb. 36.

This paper provides a general overview of forest management activities in Ontario as they relate to mixedwood forests, including current problems, practices, and information needs. (Location: Ontario)

Key words: Silviculture, vegetation control—chemical, economics—fiber, economics—nonfiber, forest policy

- Macdonald, S.E.; Lieffers, V.J. 1991.** Population variation, outcrossing, and colonization of disturbed areas by *Calamagrostis canadensis*: evidence from allozyme analysis. Am. J. Bot. 78:1123-1129.

The genetic variability of *Calamagrostis canadensis* was studied within cutblocks and native forest stands. Variability was found to be high within the species on both types of sites. The authors find that cutblocks were colonized by seedlings originating from seeds, while reproduction in native stands was primarily by vegetative propagation. (Location: 82 O)

Key words: Vegetation control—*Calamagrostis*, forest-harvesting effects, ecology

- Macdonald, S.E.; Lieffers, V.J. 1993.** Rhizome plasticity and clonal foraging of *Calamagrostis canadensis* in response to habitat heterogeneity. J. Ecol. 81:769-776.

This study experimentally assesses the rhizome development patterns of *Calamagrostis* under different site conditions. The study finds that unshaded sites with warmer soils and reduced competition were preferred. Shoots developed in shade had lower photosynthetic capability than those developed on unshaded sites. (Location: Not applicable; laboratory study)

Key words: Vegetation control—*Calamagrostis*, soil and site conditions

Macdonald, S.E.; Rothwell, R.L.; Schmidt, M.G. 1996. Impact of different methods of mechanical site preparation on foliar nutrients of planted white spruce seedlings. Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Land For. Serv., Edmonton, Alberta. Can.-Alta. Partnership Agreement For. Rep. 140.

This study evaluates the effects of mechanical site preparation on the abundance of nutrients in planted white spruce seedling leaves relative to unharvested and untreated harvested sites. Disk-trenching, ripper-ploughing, and blading were the tested site-preparation methods. The results are somewhat variable; the authors conclude that mechanical site preparation did improve foliar nutrient content during the first 2-3 growing seasons, but in the long-term can reduce foliar nutrients, particularly when soil organic layers are removed. (Location: 83 J, K)

Key words: Site preparation, soil and site conditions, reforestation, white spruce

Machtans, C.S. 1996. Riparian buffer strips: their value as habitat and movement corridors for songbirds in the boreal mixedwood forest of Alberta. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

Songbirds were found to be more common near riparian than upland sites in undisturbed areas. Forest harvesting and the creation of buffer strips along water courses were not found to affect species richness, abundance, or turnover significantly. Clear-cuts tended to limit movement to buffer strips and forested areas. (Location: 83 P)

Key words: Birds, wildlife distribution and diversity, forest-harvesting effects

MacIsaac, D.A. 1986. Crow Lake study area, north-eastern Alberta: biophysical inventory. Alta. For. Lands Wildl., Public Lands Div., Edmonton, Alberta. Tech. Rep. T/117.

A biophysical-resource analysis was conducted in the Crow Lake area (131 km²). The vegetation was sampled and classified into 16 upland and 12 wetland community types. Soils are described and lists are provided of plant and animal species. (Location: 83 P)

Key words: Ecological land classification, vegetation classification, wildlife distribution and diversity, unique resources

MacIsaac, D.A. 1995. Competition and juvenile growth in mixedwood regeneration in Manitoba. Nat. Resour. Can., Can. For. Serv., Manit. Dist. Off., Winnipeg, Manitoba, and Manit. Nat. Resour., For. Branch, Winnipeg, Manitoba. Can.-Manit. Partnership Agreement For. Rep.

This study concludes that deciduous trees are a major competition factor for juvenile white spruce growth. The study also finds that the relative height of the crop seedling to its competitor, and its proximity to overstory trees, are the best parameters for assessing growth. Threshold values for assessing competition selected indexes are also recognized. Competition indexes that incorporate radial growth were found to be better measures than height or height increment. (Location: 52 L; 62 I, N; 63 F, K)

Key words: Competition analysis, white spruce, jack pine, black spruce

MacIsaac, D.A.; Navratil, S. 1996. Competition dynamics in juvenile boreal hardwood-conifer mixtures. Pages 23-34 in P.G. Comeau and K.D. Thomas, eds. Silviculture of temperate and boreal broadleaf-conifer mixtures. Proc. Symp., February 28-March 1, 1995, Richmond, British Columbia. B.C. Minist. For., Victoria, British Columbia. Land Manage. Handb. 36.

Interspecific competition and the development of competition indexes are reviewed with a focus on effects of deciduous trees on conifer seedlings. Indexes based on tree:seedling volumes, and root-collar diameter or basal area weighted according to distances between individuals, are found to explain the greatest amount of variance. (Location: Alberta, Manitoba)

Key words: Competition analysis, aspen, lodgepole pine, black spruce, jack pine

MacIver, D.C.; Holland, W.D.; Powell, J.M. 1972. Delineation of similar summer climatic regimes in central Alberta. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-30.

A multivariate statistical approach is used in this paper to group meteorological stations with similar climatic regimes. The area included within the study is from Edmonton north to Wabasca. A tabular summary of climatic data is provided for each recognized grouping. (Location: Alberta)

Key words: Climate and related effects

- MacLeod, W.K.; Blyth, A.W. 1955.** Yield of even-aged fully stocked spruce-poplar stands in northern Alberta. Can. Dep. North. Aff. Natl. Resour., For. Branch, For. Res. Div., Ottawa, Ontario. Tech. Note 18.

Yield tables for fully stocked spruce-poplar stands were developed, based on data from central Alberta. Information for trembling aspen is provided on site index, basal area, and volume basis. (Location: 83 J, O, P)

Key words: Growth and yield, aspen

- Maher, R.V.; Argus, G.W.; Harms, V.L.; Hudson, J.H. 1979.** The rare vascular plants of Saskatchewan. Natl. Mus. Can., Ottawa, Ontario. Syllogeus 20.

Vascular plants considered rare in Saskatchewan are identified, known locations are plotted, and their status identified. Small-scale maps are included in the text to show known locations of each species. Plants considered significant in Canada are also identified. (Location: Saskatchewan)

Key words: Unique resources

- Maier, G.B.; Darrah, D. 1989.** Decay levels in mature aspen stands, Whitecourt, Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. For. Lands Wildl., For. Serv., Edmonton, Alberta. Can.-Alta. For. Resour. Dev. Agreement Rep.

An inventory of aspen-stem decay was conducted in the Whitecourt forest. Estimates found 39% of total gross tree volume showed evidence of decay and staining. Tree diameter at breast height was found to be the best predictor of decay. (Location: 83 J, K)

Key words: Forest-damage agents, economics—fiber, aspen

- Maini, J.S. 1968.** Silvics and ecology of *Populus* in Canada. Pages 20–69 in J.S. Maini and J.H. Cayford, eds. Growth and utilization of poplars in Canada. Can. Dep. For. Rural Dev., For. Branch, Ottawa, Ontario. Publ. 1205.

The available literature on the silviculture and ecological behavior of *Populus* species in Canada is reviewed. Maps are included that show the geographical distribution of each species. Information is also provided on reproduction, growth and development, root systems, and other ecological considerations. (Location: Canada)

Key words: Aspen, balsam poplar, ecology

- Malhotra, S.S.; Addison, P.A.; Khan, A.A. 1980.** Symptomology and threshold levels of air pollutant injury to vegetation, 1979–80. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 109.

This study attempts to determine the visual and physiological damage threshold levels for native plant species as a result of air pollution in the Athabasca oil sands region. Deciduous trees and shrubs were much more sensitive to sulfur dioxide than conifers. (Location: 74 D, E)

Key words: Pollution effects, vegetation assessment, white spruce, jack pine, black spruce

- Malhotra, S.S.; Blauel, R.A. 1980.** Diagnosis of air pollutant and natural stress symptoms on forest vegetation in western Canada. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-228.

The effects of pollution on forest plants are reviewed. Numerous photographs are included that illustrate the morphological effects of sulfur dioxide, hydrocarbon, salt, herbicides, pesticides, and other forms of damage to foliage. Both tree species and ground vegetation are assessed. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Pollution effects, vegetation assessment

- Malik, N.; Vanden Born, W.H. 1986.** Use of herbicides in forest management. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-282.

This report discusses the use of and need for herbicides in forest and silvicultural management practices in Canada. It provides information on the herbicides being used in different regions of Canada, and their impact on the environment. Recommendations are made for future herbicide use and areas of study. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Vegetation control—chemical

- Mallett, K.I. 1990. Host range and geographic distribution of *Armillaria* root rot pathogens in the Canadian prairie provinces. Can. J. For. Res. 20:(12)1859–1863.**

The following species of *Armillaria* root rot were found in the prairie provinces: *A. ostoyae*, *A. sinapina*, and *A. calvescens*. For each species, a general geographic distribution is provided and their host identified. The authors found *Armillaria* in association with both tree and shrub species. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-damage agents

- Mallett, K.I. 1992. *Armillaria* root rot in the Canadian prairie provinces. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-329.**

This paper summarizes the taxonomy, geographical distribution, symptoms and signs, damage, and host plants of *Armillaria*. Several silvicultural options are suggested for controlling this damage agent. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-damage agents, aspen, white spruce, lodgepole pine, jack pine, white birch, balsam fir

- Mallett, K.I. 1994. *Armillaria* root disease. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 33.**

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of *Armillaria* root disease. (Location: Canada)

Key words: Forest-damage agents, pest control

- Mallett, K.I.; Volney, W.J.A. 1990. Relationships among jack pine budworm damage, selected tree characteristics, and *Armillaria* root rot in jack pine. Can. J. For. Res. 20:(11)1791–1795.**

This paper attempts to determine if jack pine infected with *Armillaria* are more prone to invasion by budworms, and vice versa. The authors concluded that their data did not provide any clear proof of such a relationship. It is recommended that to minimize these problems, infected stands be harvested early and the amount of infections be reduced after harvesting. (Location: 73 H)

Key words: Forest-damage agents, jack pine

- Manning, G.H.; Grinnell, H.R. 1971. Forest resources and utilization in Canada to the year 2000. Environ. Can., Can. For. Serv., Ottawa, Ontario. Publ. 1304.**

This report estimates the demand for Canadian forest products up to the year 2000 and the available wood supply to meet the demand. The authors conclude that there is an adequate supply in Canada. (Location: Canada)

Key words: Economics—fiber

- Marsden, B.J. 1995. Effects of humidity on photosynthesis and water relations of white spruce seedlings. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.**

See Marsden et al. (1996).

- Marsden, B.J.; Lieffers, V.J.; Zwiazek, J.J. 1996. The effects of humidity on photosynthesis and water relations of white spruce seedlings during the early establishment phase. Can. J. For. Res. 26:1015–1021.**

A combination of field and laboratory experiments suggests that white spruce seedlings grown at high humidity levels have greater levels of carbon dioxide exchange, photosynthesis, and water-use efficiency. Increased root growth was found among seedlings grown on moist soils with high atmospheric humidity differences, but a decrease occurred on dry soils. It was also found that bud flush occurred 3 days later on sites with low humidity levels. Also see Marsden (1995). (Location: 83 J)

Key words: Reforestation, ecology, climate and related effects, soil and site conditions

Maruyama, P.J. 1991. Fire blight. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 4.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of fire blight. (Location: Canada)

Key words: Forest-damage agents, pest control

Maruyama, P.J.; Hiratsuka, Y. 1991. Silverleaf. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 1.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of silverleaf. (Location: Canada)

Key words: Forest-damage agents, pest control

Maynard, D.G. 1990. Biomonitoring forests near two sour gas processing plants. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-311.

This report summarizes the results of a 5-year study that monitored the effects of sulfur deposition from sour-gas plants on forest vegetation and soils. Effects were observed only within a 2- to 3-km radius of the emission source, and significant impact occurred only within 1 km, where concentrations exceeded 450 kg/ha. Sulfur deposition affected (in order of response): mosses, herbs, shrubs, and trees. (Location: 83 B)

Key words: Pollution effects, environmental impacts, vegetation assessment, soil survey, lodgepole pine

Maynard, D.G. 1993. The influence of hexazinone on carbon dioxide evolution and mineralization of nitrogen, phosphorus, and sulfur in a forest soil. Can. J. Soil. Sci. 73:433-445.

Laboratory incubation of deciduous forest litter horizons were treated with a single or a double dosage of the herbicide hexazinone and tracked for 150 days. This study finds that hexazinone did not affect soil respiration as reflected by carbon dioxide evolution, net nitrogen or sulfur mineralization rates. An increase

was observed in phosphorus on the last day of the study. (Location: 83 L)

Key words: Vegetation control—chemical, soil and site conditions

Maynard, D.G.; Fairbairns, M.D. 1994. Boreal ecosystem dynamics of ARNEWS plots: base line studies in the prairie provinces. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-327.

For this study, the biophysical resources of 12 pollution-monitoring sites were surveyed. Three sites were boreal mixedwood stands. Included in the site assessment is a description of regional site, climatic, and soil conditions; overstory composition; stand density; and understory vegetation composition and percentage cover. Soil and plant foliar nutrient contents are also summarized for each site. (Location: 63 D; 73 H)

Key words: Vegetation assessment, soil survey, pollution effects

Maynard, D.G.; Stadt, J.J.; Mallett, K.I.; Volney, W.J.A. 1994. Sulfur impacts on forest health in west-central Alberta. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-334.

This study summarizes the results of a 10-year study of sulfur deposition from two sour-gas plants on vegetation and soils. The study concludes that no widespread decline in forest health was occurring at sites within 6 km of the sulfur dioxide source, except on areas dusted with sulfur. (Location: 83 B)

Key words: Pollution effects, soil and site conditions, vegetation assessment, lodgepole pine, aspen

McDonald, C.S. 1979. Status of the hardwood resource in Alberta. Pages 23-30 in J.A. McIntosh and M.N. Carroll, eds. Utilization of western Canadian hardwoods. Proc. Symp., November 21-22, 1979, Prince George, British Columbia. Forintek Can. Corp., Vancouver, British Columbia. Spec. Publ. SP-2.

An overview of deciduous forest species in Alberta is presented under the following topics: species distribution and quality; volume of the

resource; use; stumpage policies; and export policies for logs and chips. Approximately 77% of all aspen and balsam poplar supplies occurred in the boreal portion of Alberta. (Location: Alberta)

Key words: Economics—fiber, aspen, balsam poplar, forest policy

- McDonald, L. 1995. Relationship between northern flying squirrels and stand age and structure in aspen mixedwood forests in Alberta. Pages 227–240 in J.B. Stelfox, ed. Relationship between stand age, stand structure, and biodiversity in aspen mixedwood forests in Alberta. Alta. Environ. Cent., Vegreville, Alberta, Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Alta. Land For. Serv., Edmonton, Alberta.**

This study compares the abundance of flying squirrels in three age classes composed of 12 stands ranging from 23 to 146 years old and various stand characteristics. The abundance of flying squirrels was found to be greatest in older stands, which tend to have a greater potential for denning cavities. Flying-squirrel abundance is also positively associated with the occurrence of increased white spruce and shrub densities. (Location: 73 L; 83 P)

Key words: Wildlife distribution and diversity, small mammals, aspen

- McLaughlin, J.A.; Dumas, M.T. 1996. Pathological implications of partial cutting in boreal mixedwood stands. Pages 167–169 in C.R. Smith and G.W. Crook, comp. Advancing boreal mixedwood management in Ontario. Proc. Workshop, October 17–19, 1995, Sault Ste. Marie, Ontario. Nat. Resour. Can., Can. For. Serv., Great Lakes For. Cent., Sault Ste. Marie, Ontario, and Ont. Minist. Nat. Resour., Sault Ste. Marie, Ontario.**

A brief overview is provided on the potential impact of *Armillaria* in partially harvested aspen stands. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-damage agents, aspen

- Messier, C. 1996. Managing light and understorey vegetation in boreal and temperate broad-leaf-conifer forest. Pages 59–80 in P.G.**

Comeau and K.D. Thomas, eds. Silviculture of temperate and boreal broadleaf-conifer mixtures. Proc. Symp., February 28–March 1, 1995, Richmond, British Columbia. B.C. Minist. For., Victoria, British Columbia. Land Manage. Handb. 36.

This paper provides information on studies of the amount of light that penetrated different types of forest canopies and was available to understory plants. These studies include examples from Canada and other countries. Solar radiation flux on a diurnal basis is summarized for openings in the forest canopy. Six different types of forest understory illumination/shade are recognized: forest shade, small gap shade, gap edge shading, small gap openings, large gap openings, and forest edge openings. (Location: Not applicable; literature review)

Key words: Ecology, forest-harvesting effects, climate and related effects

- Miller, A.C. 1974. Poplar management in Saskatchewan. Pages 43–50 in R.W. Neilson and C.F. McBride, eds. Poplar utilization symposium. Proc., May 23–24, 1974, Edmonton, Alberta. Can. Dep. Environ., Can. For. Serv., West. For. Prod. Lab., Vancouver, British Columbia. Inf. Rep. VP-X-127.**

The extent and quantities of aspen and balsam poplar are summarized for Saskatchewan. This includes an assessment by diameter classes. In the early 1970s, only about 8% of the available annual allowable cut was being used, but a significant portion of the supply contained rot. (Location: Saskatchewan)

Key words: Economics—fiber, tree-crop production, balsam poplar, aspen

- Miller, W.S.; Auclair, A.N. 1974. Factor analytic models of bioclimate for Canadian forest regions. Can. J. For. Res. 4:536–548.**

This study analyzes the relationship between climate and the distribution of forest types using principal component analysis. Results reveal that classification of forest regions by cluster analysis of climatic data has potential for forestry applications. (Location: Canada)

Key words: Climate and related effects, vegetation assessment

Montero, J.A. 1994. Evaluation of mechanical site preparation on physical soil properties of three boreal mixedwood sites. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

This study compares the effects of disk-trenching, ripper-ploughing, and blading on soil density, moisture content, structure, organic content, drainage, and erosion potential. The author concludes that all three methods improve physical soil conditions for planting compared to untreated sites. Ripper-ploughing was found to produce more high sites (the preferred planting location) than the other methods. Preference for the ripper plough was because of better drainage and reduced bulk density, and its suitability for use on frozen ground. (Location: 83 J, K)

Key words: Site preparation, soil and site conditions, erosion assessment, reforestation

More, G. 1978. Ecological aspects of food selection in pine marten (*Martes americana*). M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

This food-selection study conducted in the southern Northwest Territories finds that boreal red-backed voles and meadow voles are the principal prey of pine marten. Red squirrel and snowshoe hare were infrequent prey, and deer mice were rarely selected. Marten have a bimodal activity period—early morning and evening in summer—that is modified in fall and winter. This change in behavior could be attributed to day length. (Location: 85 C)

Key words: Wildlife-habitat assessment, furbearers, small mammals

Morrall, R.A.A. 1964. An ecological study of soil microfungi of upland boreal forests at Candle Lake, Saskatchewan. M.A. thesis, Univ. Sask., Saskatoon, Saskatchewan.

The microfungal character of boreal forest soils is examined in jack pine-black spruce, aspen, and white spruce-birch stands. While approximately 180 species were found, only a few were common: *Mortierella vinacea*, *M. ramanniana*, *M. isabelliana*, and *Pullularia pullulans*. Seasonal fluctuations in species frequency were found for only a few species. (Location: 73 H)

Key words: Vegetation assessment, ecology, soil and site conditions

Morrall, R.A.A. 1974. Soil microfungi associated with aspen in Saskatchewan: synecology and quantitative analysis. Can. J. Bot. 52:1803-1817.

A soil survey of microfungi associated with aspen was conducted over a wide geographical area and ecological range. The microfungal communities of aspen stands in the boreal forests of Saskatchewan appear to have a distinctive character, i.e., an abundance of *Mortierella* spp. (Location: Saskatchewan)

Key words: Vegetation assessment, ecology, soil and site conditions

Morrall, R.A.A.; Vanterpool, T.C. 1968. The soil microfungi of upland boreal forests of Candle Lake, Saskatchewan. Mycologia 60:642-654.

This study investigates soil microfungi in upland boreal forests at Candle Lake, Saskatchewan. A total of 113 taxa were isolated and identified. The microfungi showed a pattern of continuous variation among the sampled forest communities, but are not clearly correlated with the dominant vegetation. (Location: 73 H)

Key words: Vegetation assessment, ecology, soil and site conditions

Moss, E.H. 1938. Longevity of seed and establishment of seedlings in species of *Populus*. Bot. Gaz. 99:529-542.

This paper investigates how aspen reproduce by seed. Results indicate that poplar seedlings require moisture continuously in the surface layers of the soil for at least the first week of growth. This is due to the slow growth of the primary root. (Location: 83 H)

Key words: Aspen, ecology, plant propagation

Moss, E.H. 1953. Forest communities in northwestern Alberta. Can. J. Bot. 31: 212-252.

This paper is an early description of the floristic composition and ecological relationships of the chief forest types in the northwestern portion of Alberta. White spruce is recognized as the climax species for the area. Fire is considered an impediment to the natural succession

of poplar and pine to white spruce. (Location: Northwestern Alberta)

Key words: Vegetation assessment, ecology, fire ecology

Moss, E.H. 1955. The vegetation of Alberta. Bot. Rev. 21:493-567.

This paper provides an overview of the vegetation in Alberta with a section on boreal forests. Several broad vegetation types are recognized and described in terms of composition and site conditions. This article is very general compared to more recent work. (Location: Alberta)

Key words: Ecological land classification, vegetation classification, soil and site conditions

Murphy, P.J. 1988. Policy development needs for successful mixedwood management. Pages 138-144 in J.K. Samoil, ed. Management and utilization of northern mixedwoods. Proc. Symp., April 11-14, 1988, Edmonton, Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-296.

The author discusses several topics related to forest policy development, including a policy-development framework, goals and objectives, land tenure, professionalism, and tree improvement. (Location: Alberta)

Key words: Forest policy

Murray, W.A. 1981. The 1981 snowpack survey in the AOSERP study area. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 125.

This study explores whether winter pollutant deposition rates and the resultant snowpack load increased proportionately in a 1981 study. Results indicated that the amounts of sulfate and nitrate deposited in the snow within 25 km of the oil sands plants had increased by 88 and 27%, respectively. The amount of insoluble particulates decreased markedly. (Location: 74 D, E)

Key words: Pollution effects, climate and related effects

Myrholm, C.L.; Cerezke, H.F. 1994. Pitch blister moths. Nat. Resour. Can., Can. For. Serv.,

Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 30.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agents; and prevention and control of pitch blister moths. (Location: Canada)

Key words: Forest-damage agents, pest control

Mytton, W.R.; Keith, L.B. 1981. Dynamics of moose populations near Rochester, Alberta, 1975-1978. Can. Field-Nat. 95:39-49.

This paper considers the population demography, movement, distribution, and habitat use of radio-collared moose near Rochester. Moose were located on aspen islands in muskegs during summer months. They moved to tall, high density upland aspen and coniferous stands in December through March. (Location: 83 J)

Key words: Wildlife distribution and diversity, wildlife-habitat assessment, ungulates

Navratil, S. 1995. Minimizing wind damage in alternative silviculture systems in boreal mixedwoods. Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Land For. Serv., Edmonton, Alberta. Can.-Alta. Partnership Agreement For. Rep. 124.

The effects of wind on various silvicultural systems are reviewed with respect to wind speed, root systems, tree-growth patterns, topography, and site conditions. Recommendations are made to minimize wind damage. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-harvesting effects, climate and related effects, site preparation

Navratil, S. 1996a. Silvicultural systems for managing deciduous and mixedwood stands with white spruce understorey. Pages 35-46 in P.G. Comeau and K.D. Thomas, eds. Silviculture of temperate and boreal broadleaf-conifer mixtures. Proc. Symp., February 28-March 1, 1995, Richmond, British Columbia. B.C. Min. For., Victoria, British Columbia. Land Manage. Handb. 36.

This paper reviews advantages of protecting white spruce in the understorey of deciduous or mixedwood boreal forest stands. Among the

benefits described are improved conifer yield, wildlife-habitat suitability, and biodiversity. A major disadvantage noted is that understory conifer protection required more planning and management than traditional clear-cutting. (Location: Alberta)

Key words: Understory protection, white spruce, uneven-aged stand management, growth and yield

- Navratil, S. 1996b. Sustained aspen productivity on hardwood and mixedwood sites. Pages 53-64 in P.G. Comeau, G.J. Harper, M. Blache, J.O. Boateng, and K.D. Thomas, eds. *Ecology and management of British Columbia hardwoods. Workshop Proc.*, December 1-2, 1993, Richmond, British Columbia. Nat. Resour. Can., Can. For. Serv., Pac. For. Cent., Victoria, British Columbia, and B.C. Minist. For., Victoria, British Columbia. Can.-B.C. Partnership Agreement For. Resour. Dev. FRDA II Rep. 255.

Not available for review.

Key words: Aspen, white spruce, economics—fiber

- Navratil, S. 1996c. Understory protection in Alberta's boreal mixedwoods: selecting the best silvicultural system for stands with conifer understory. Pages 197-201 in C.R. Smith and G.W. Crook, comp. *Advancing boreal mixedwood management in Ontario. Proc. Workshop*, October 17-19, 1995, Sault Ste. Marie, Ontario. Nat. Resour. Can., Can. For. Serv., Great Lakes For. Cent., Sault Ste. Marie, Ontario, and Ont. Minist. Nat. Resour., Sault Ste. Marie, Ontario.

A wide range of silvicultural options exists to manage conifer understory in deciduous and deciduous-conifer stands. Steps in selecting the best silvicultural option include defining management objectives, evaluating stand suitability, and assessing risk to wind damage. (Location: Alberta)

Key words: Understory protection, silviculture, aspen, white spruce

- Navratil, S.; Bella, I.E. 1989. Regeneration, development and density management in aspen stands. Pages 19-38 in R.L. Gambles, comp.

Management and utilization of Alberta's poplars. Proc. Tenth Annu. Meet. Poplar Council Can., October 26-28, 1988, Edmonton, Alberta. Poplar Council Can., Toronto, Ontario.

This paper reviews work on regeneration silviculture and the early development of aspen, and provides preliminary guidelines for density management of aspen stands. High densities of aspen suckers are associated with winter cuts and sites without slash, although natural thinning results in a rapid decline during the first 5 years of growth after disturbance. (Location: Not applicable; literature review)

Key words: Tree-crop production, site preparation, juvenile stand-tending, aspen, forest-harvesting effects

- Navratil, S.; Bella, I.E.; Peterson, E.B. 1990. Silviculture and management of aspen in Canada: the western Canada scene. Pages 39-60 in R.D. Adams, ed. *Aspen symposium '89. Proc. Symp.*, July 25-27, 1989, Duluth, Minnesota. U.S. Dep. Agric., For. Serv., North Central For. Exp. Stn., St. Paul, Minnesota. Gen. Tech. Rep. NC-140.

This paper briefly reviews the aspen resource in British Columbia and the prairie provinces. Its primary focus is on aspen regeneration and silviculture, density management, growth and yield prediction, and the problems of aspen management. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Aspen, growth and yield, silviculture, ungulates, furbearers, pollution effects

- Navratil, S.; Brace, L.G.; Sauder, E.A.; Lux, S. 1994. Silvicultural and harvesting options to favor immature white spruce and aspen regeneration in boreal mixedwoods. *Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-337.*

This report documents the design and initial results of two long-term studies on protecting advanced regeneration in mixedwood forest stands. A variety of treatments were tested, using different harvesting designs and equipment. The paper includes schedules for future studies. Preliminary results suggest that 52-61% of understory trees can be protected, trees less than 7-m tall and within 70 m of lee

side of cut areas are seldom blown down, and roadside harvesting equipment was better than cut-to-length equipment for protecting understory trees. (Location: 83 F, K; 84 E)

Key words: Understory protection, forest-harvesting effects, white spruce, aspen, balsam poplar

- Navratil, S.; Chapman, P.B., eds. 1991. **Aspen management for the 21st century. Proceedings of a symposium held November 20–21, 1990, in Edmonton, Alberta, in conjunction with 12th annual meeting of the Poplar Council of Canada.** For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta, and Poplar Council, Edmonton, Alberta.

This symposium included papers from a variety of sources (e.g., foresters, wildlife biologists, members of the public), all with an orientation toward aspen forest silvicultural management, resource conservation, and related, wide-ranging topics. (Location: Canada)

Key words: Aspen, balsam poplar, growth and yield, tree-crop production, understory protection, pollution effects, juvenile stand-tending, soil and site conditions, economics—nonfiber, unique resources, ungulates, birds

- Navratil, S.; Hayward, R.; Brace, L. 1996. **Management of aspen regeneration density on boreal mixedwood sites.** Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Land For. Serv., Edmonton, Alberta. Can.-Alta. Partnership Agreement For. Rep. 139.

This paper compares the effectiveness of various mechanical and chemical treatments to control aspen regeneration. Included in the analysis are five separate studies located in the Boreal Mixedwood and Lower Boreal-Cordilleran ecoregions. The "punch and fill" chemical treatment method tended to be the most effective, with a greater than 80% reduction in aspen relative to control sites. Two-pass Rome disking was the most effective mechanical method. (Location: 73 P; 83 G, L; 84 C, D)

Key words: Vegetation control—mechanical, vegetation control—chemical, juvenile stand-tending, site preparation

- Navratil, S.; Lane, J. 1987. **Control of aspen development in areas designated for softwood production: summary of satellite trials A, B, and C.** Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. For. Lands Wildl., Alta. For. Serv., For. Res. Branch, Edmonton, Alberta. Can.-Alta. For. Resour. Dev. Agreement Rep.

Site preparation and preharvesting chemical treatment were tested as means of aspen suppression for the development of pure softwood stands and superior aspen stands. Methodologies and preliminary findings of three trials in the Calling Lake area, Weberville Demonstration area, and Hines Creek area are provided. (Location: 83 P; 84 C, D)

Key words: Aspen, vegetation control—chemical, vegetation control—mechanical

- Navratil, S.; MacIsaac, D.A. 1993. **Competition index for juvenile mixed stands of lodgepole pine and aspen in west-central Alberta.** For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Manage. Note 57.

Several indexes are proposed to represent the degree of competition that occurs between developing lodgepole pine seedlings in mixedwood stands. These indexes are based on common height and basal-diameter measurements, and distance measurements between the crop seedlings and other trees. (Location: Western Alberta)

Key words: Competition analysis, lodgepole pine, aspen

- Navratil, S.; MacIsaac, D.A. 1996. **Juvenile growth of white spruce and deciduous competition on mixedwood sites in Alberta.** Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Environ. Prot., Land For. Serv., Edmonton, Alberta. Can.-Alta. Partnership Agreement For. Rep. 141.

The relationship between white spruce seedling growth and generalized measures of vegetation is statistically evaluated and modeled. The studied cutblocks were either mechanically treated or had no site preparation prior to planting. Results indicate that white spruce growth generally decreases with increasing competition from deciduous vegetation, but is also poor under low competition stress.

Competition is considered to have a significant effect when deciduous trees with a basal diameter of 2.5 times that of white spruce occurred within 2 m of the crop seedling. (Location: 73 P; 83 B, L, M)

Key words: Competition analysis, ecology, white spruce, aspen

- Navratil, S.; Phillips, P.; Morton, R. 1990. Aspen competition and lodgepole pine growth in mixed regeneration in western Alberta. Pages 43-44 in E. Hamilton, comp. *Vegetation management: an integrated approach*. Proc. Fourth Annu. Veg. Manage. Workshop, November 14-16, 1989, Vancouver, British Columbia. For. Can., Pac. Yukon Reg., Pac. For. Cent., Victoria, British Columbia, and B.C. Minist. For., Victoria, British Columbia. Can.-B.C. For. Resour. Dev. Agreement Rep. 109.

This paper estimates the effects of aspen on the growth of 4- to 12-year-old pine in mixed-wood stands. A modified growth model (Chapman Richards function) suggests that a 10-12% aspen cover is beneficial to lodgepole seedling growth, while higher levels of cover are detrimental. (Location: Western Alberta)

Key words: Competition analysis, aspen, lodgepole pine

- Nelson, S.J. 1983. *Ecological land classification and evaluation: Sturgeon Lake-Puskwaskau East*. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/11-9.

An ecological land classification (1:100 000) was conducted in the Sturgeon Lake area of west-central Alberta (5760 km²). Included within this study is a classification of understory vegetation types. Land-resource evaluations are given for till crops, improved grazing, moose habitat, tree growth, and potential hazards. (Location: 83 K, M, N)

Key words: Ecological land classification, vegetation classification, land evaluation

- Nelson, S.J.; O'Leary, D.; Downing, D. 1989. Holmes Crossing proposed natural area biophysical inventory. Alta. For. Lands Wildl., Land Inf. Serv. Div., Edmonton, Alberta. Pub. T/200.

A biophysical inventory (1:20 000) was conducted in the proposed Holmes Crossing Natural Area (49 km²). This report summarizes environmental, historical, and land-use information; and identifies, describes, and maps soils and landform features, plant communities, and special features. (Location: 83 J)

Key words: Ecological land classification, vegetation classification, unique resources

- Nelson, S.J.; Hay, W.; Mikalchuk, G. 1988. *Ecological land classification of the Yellowhead North*. Alta. For. Lands Wildl., Land Inf. Serv. Div., Edmonton, Alberta. Pub. T/167.

An ecological land classification (1:100 000) was conducted in the Yellowhead North planning area (5438 km²). This report provides baseline data on each ecoregion and ecosection in the area in terms of soils, drainage, vegetation physiognomy, and plant associations. (Location: 83 E, F)

Key words: Ecological land classification, vegetation classification

- Nielson, P.L. 1975. *The past and present status of the plains and boreal forest grizzly bear in Alberta*. Can. Wildl. Serv., Edmonton, Alberta.

This paper is a historical review of grizzly bear distribution and abundance in Alberta. The study suggests that grizzly bear were much more widely distributed in the past than at the time of the study, when they were generally confined to the foothills and mountains in western Alberta. (Location: Alberta)

Key words: Furbearers, wildlife distribution and diversity

- Nietfeld, M.T. 1983. *Foraging behaviour of wapiti in the boreal mixed-wood forest, central Alberta*. M.S. thesis, Univ. Alta., Edmonton, Alberta.

The feeding habits of elk are compared in different habitats: poplar forest, willow, upland grassland, and sedge meadow. Use differences were found among the types by season. Included in this study are herb and shrub biomass estimates. (Location: 83 H)

Key words: Wildlife-habitat assessment, ungulates, vegetation assessment

Nietfeld, M.; Hudson, R.J. 1985. Foraging ecology of wapiti in the boreal mixed-wood forest, central Alberta. Pages 131-139 in R.W. Nelson, ed. Proc. 1984 West. States Prov. Elk Workshop, April 17-19, 1984, Edmonton, Alberta. Alta. Fish Wildl., Edmonton, Alberta.

This paper discusses forage selection by elk in five habitat types in boreal mixedwood forests of central Alberta. Dietary crude protein was considered sufficient to meet the requirements of elk throughout the year, but was best during the spring and summer. (Location: Alberta)

Key words: Ungulates, wildlife-habitat assessment

Nietfeld, M.; Wilk, J.; Woolnough, K.; Hoskin, B. 1985. Wildlife habitat requirement summaries for selected wildlife species in Alberta. Alta. Energy Nat. Resour., Fish. Wildl. Div., Edmonton, Alberta. Tech. Rep. T/73.

This manual summarizes and defines the relationship between Alberta's wildlife species and their respective habitats. Included in this review are a variety of wildlife species, with maps depicting primary and secondary habitat areas. (Location: Alberta)

Key words: Ungulates, furbearers, birds, wildlife-habitat assessment, wildlife distribution and diversity

Novakowski, N.S. 1967. The winter bioenergetics of a beaver population in northern latitudes. Can. J. Zool. 45:1107-1118.

The results of this study indicate that beaver in northern latitudes are confined to a subnivean existence for approximately 150 days each year. Given this long period of confinement, their deciduous food cache is insufficient to meet energy requirements; therefore to conserve energy, adult beavers reduce activity, have longer periods of dormancy, huddle, and increase their fur insulation and fat reserves. (Location: 74 L)

Key words: Wildlife-habitat assessment, furbearers

Nowlin, R.A. 1978. Relationship between habitats, forage, and carrying capacity of moose range in northern Alberta. Part 1. Moose preferences for habitat strata and forages. Alta.

Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 33.

Moose appear to prefer upland over lowland habitats, especially during the fall and winter, except for nonfeeding and nonbedding activities. In both seasons, aspen and aspen-white spruce stands are preferred, while black spruce and black spruce-larch habitats are avoided or seldom used. (Location: 74 D, F)

Key words: Wildlife-habitat assessment, ungulates, vegetation assessment

Ojamaa, P.M. 1977a. Ecological land classification: Fort Vermilion Grazing Reserve study area. Alta. Energy Nat. Resour., Edmonton, Alberta.

An ecological land classification based on 1:31 680-scale air photos was completed for the Fort Vermilion Grazing Reserve. The physiography, soils, and ecological conditions are provided for each ecosection. Establishment ratings for forage are given, as well as site limitations. (Location: 84 K)

Key words: Ecological land classification, land evaluation, forest grazing

Ojamaa, P.M. 1977b. Ecological land classification: Manning Grazing Reserve study area. Alta. Energy Nat. Resour., Edmonton, Alberta.

An ecological land classification based on 1:31 680-scale air photos was completed for the Manning Grazing Reserve. The physiography, soils, and ecological conditions are provided for each ecosection. Establishment ratings for forage are given, as well as site limitations. (Location: 84 C)

Key words: Ecological land classification, land evaluation, forest grazing

Ojamaa, P.M. 1978a. Biophysical analysis and evaluation of capability: Cold Lake. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. 59.

A biophysical land classification (1:126 720) was developed for an area located west of Cold Lake (3830 km²). The report summarizes the natural resources of the area on an ecosection basis, but is primarily oriented toward the physical resources. Capability ratings are

developed for agriculture, forestry, recreation, ungulates, and waterfowl. (Location: 73 L)

Key words: Ecological land classification, land evaluation

- Ojamaa, P.M. 1978b. Biophysical analysis and evaluation of capability: Little Smoky. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. 60.**

A biophysical land classification (1:126 720) was completed for Little Smoky study area (6900 km²). The report summarizes the natural resources of the area on an ecosection basis, but is primarily oriented toward the physical resources. Capability ratings are developed for agriculture, forestry, recreation, ungulates, and waterfowl. (Location: 83 K)

Key words: Ecological land classification, land evaluation

- Ojamaa, P.M. 1978c. Ecological (biophysical) land classification: Three Creeks Grazing Reserve study area. Alta. Energy Nat. Resour., Resour. Plann. Branch, Edmonton, Alberta.**

A biophysical classification was prepared for the Three Creeks area (200 km²) location northeast of Peace River. Soils and topography are the typical characteristics provided for each ecosection. Ratings and limitations are given for the establishment of forage crops. (Location: 84 C)

Key words: Ecological land classification, land evaluation, forest grazing

- Ojamaa, P.M. 1979. Ecological land classification: Pembina Grazing Reserve study area. Alta. Energy Nat. Resour., Resour. Plann. Branch, Edmonton, Alberta.**

An ecological land classification was completed for the Pembina Grazing Reserve study area (512 km²). Grazing potential is described in terms of its growth and yield, and its dependence on climate (precipitation), soils, drainage, and slope. (Location: 83 G)

Key words: Ecological land classification, land evaluation, forest grazing

- O'Leary, D.J. 1986. Ecological assessment of the agricultural, wildlife and forestry resources of**

the Cold Lake integrated resource planning area. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta.

For this study, land capability/suitability assessments were prepared for several resources. The criteria for evaluating wildlife-habitat suitability are not clearly defined, while tree growth is based on site index at 50 years, stratified by soil series. (Location: 73 L)

Key words: Land evaluation, soil and site conditions, furbearers, ungulates, small mammals

- O'Leary, D.J.; Downing, D. 1986a. Integrated resource inventory: Grande Prairie County West study area. Vol 1. Ecological land classifications and evaluations. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. T/130-1.**

A 1:100 000 ecological land classification was developed to the ecosection level for a 930-km² area west of Grande Prairie. A general description is provided for each ecosection, as well as assessments for improved and unimproved grazing suitability, elk and furbearer habitat suitability, and forest productivity. (Location: 83 M)

Key words: Ecological land classification, land evaluation, forest grazing, wildlife-habitat assessment, soil and site conditions

- O'Leary, D.J.; Downing, D. 1986b. Integrated resource inventory: Grande Prairie County West study area. Vol 2. Vegetation classification. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. T/130-2.**

Thirteen plant community-types are defined and described for a 930-km² area west of Grande Prairie. Included as part of the community-type descriptions are site conditions, floristic composition, and forest-mensuration characteristics of the forest stands. Raw plot data are also provided. (Location: 83 M)

Key words: Vegetation classification, growth and yield, soil and site conditions

- O'Leary, D.; Downing, D.; Schindler, D.; Boyd, L. 1986. Integrated resource inventory for the Kimsan-Winagami study area. Alta. For. Lands Wildl., Resour. Eval. Plann. Div., Edmonton, Alberta. Publ. T/119-1.**

This study is an integrated-resource inventory (1:100 000) of the Kimiwan-Winagami study area (550 km²), which was completed in 1985. Volume I provides the area's physical and biological characteristics of the landscape and land evaluations for agriculture, forestry, and wildlife. Volume II describes the floristic and environmental factors of the plant associations. (Location: 84 C, N)

Key words: Ecological land classification, vegetation classification, soil and site conditions

Packer, J.G.; Bradley, C.E. 1984. A checklist of the rare vascular plants in Alberta. Alta. Cult., Hist. Resour. Div., Edmonton, Alberta. Nat. Hist. Occas. Pap. 5.

Plant species considered rare in Alberta are listed, and their known ranges in North America described. Maps of reported occurrences in Alberta are provided. This report has been replaced by Gould (1999) lists. (Location: Alberta)

Key words: Unique resources

Padbury, G.A.; Head, W.K.; Souster, W.E. 1978. Biophysical resource inventory of Prince Albert National Park, Saskatchewan. Univ. Sask., Sask. Inst. Pedol., Saskatoon, Saskatchewan. Publ. S185.

Soils, landforms, and vegetation in Prince Albert National Park are inventoried and mapped. The vegetation is organized into vegetation types; most of these types are aspen or aspen-spruce communities. The abundance of species is summarized by cover classes. Plant communities are also assessed for their sensitivity to recreational use. Some chemical and physical attribute data are provided for selected soil associations. (Location: 73 G, J)

Key words: Vegetation classification, physical land classification and geology, vegetation assessment, land evaluation, soil and site conditions

Padbury, G. 1986. Potential of soils and bedrock to neutralize acid, Saskatchewan, 1:2,000,000 scale map. Agric. Can. and Sask. Dep. Environ., Regina, Saskatchewan.

Not available for review. (Location: Saskatchewan)

Key words: Pollution effects, environmental impacts

Park, J.; Bennett, K.J. 1983. Integrated resource inventory of the Wapiti Sand Dunes study area. Alta. Energy Nat. Resour., Edmonton, Alberta.

A physical and ecological land classification and a descriptive report were prepared for an area located southeast of Grande Prairie. Recreation-use limitations based on soil constraints were compiled for ecosites. Most uses are rated as having potentially severe conditions. (Location: 83 M)

Key words: Ecological land classification, physical land classification and geology, vegetation assessment, soil and site conditions

Parker, R.W. 1978. The influence of atmospheric sulphur emissions on nutrient return via throughfall and stemflow in three boreal ecosystems. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

During the summers of 1976 and 1977, field-research plots were established to determine the distribution of rainfall under stands of aspen, jack pine, and black spruce. Determinations are provided of the relative amounts of sodium, potassium, calcium, magnesium, and sulfur returned to the soil and recycled from trees to soil in throughfall, stemflow, and litter-fall. The effect of sulfur emissions from oil-sands plants on nutrient return is investigated. (Location: 74 E)

Key words: Pollution effects, climate and related effects, ecology, aspen, jack pine, black spruce

Parry, D. 1994. The impact of predators and parasitoids on natural and experimentally created populations of forest tent caterpillars, *Malacosoma disstria* Hubner (Lepidoptera: Lasiocampidae). M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

See Parry, Spence, and Volney (1997). (Location: 83 G)

Key words: Pest control, invertebrates

Parry, D. 1995. Larval and pupal parasitism of the forest tent caterpillar, *Malacosoma disstria*

Hubner (Lepidoptera: Lasiocampidae), in Alberta, Canada. *Can. Entomol.* 127:877-893.

Parasites of forest tent caterpillars in the larval and pupal stages of development were surveyed in endemic, outbreak, and postoutbreak populations. Eighteen species of parasite were found in association with the forest tent caterpillar. *Aleiodes malacosomatos* occurred in endemic populations, while *Leschenaultia exul* and *Patelloa pachypygus* were more commonly associated with outbreak and postoutbreak populations. (Location: 73 L; 83 B, H, N, O; 84 C)

Key words: Pest control, invertebrates

Parry, D.; Spence, J.R.; Volney, J.A. 1997. Responses of natural enemies to experimentally increased populations of the forest tent caterpillar, *Malacosoma disstria*. *Ecol. Entomol.* 22:97-108.

The effects of parasites and birds on the abundance of forest tent caterpillars were experimentally tested. It was found that birds had a much larger impact on the species than parasites. A different parasite species occurred on the two studied site types. The authors suggest factors that disturb predation can lead to outbreaks of forest tent caterpillars. *Also see* Parry (1994). (Location: 83 G)

Key words: Pest control, invertebrates, birds

Parry, D.; Volney, W.J.A.; Currie, C.R. 1997. The relationship between trembling aspen phenology and larval development of the large aspen tortrix. *Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-350.*

The development of the large aspen tortrix with respect to its host plant is poorly understood. For this study, degree-day models were developed for both the insect and the bud and shoot development of its host. Clonal control of phenological development of aspen, and microsite differences in temperature regimes, are two factors that must be considered to improve models that predict phenological events. (Location: 73 G)

Key words: Forest-damage agents, aspen, climate and related effects

Paul, G.; Etheridge, D.E. 1958. Decay of aspen (*Populus tremuloides* Michx.) and balsam

poplar (*Populus balsamifera* L.) in the Lesser Slave Lake region of Alberta. *Alta. Dep. Lands For., For. Wildl. Div., Edmonton, Alberta, and Can. Dep. Agric., For. Biol. Div., For. Biol. Lab., Calgary, Alberta.*

This interim report provides preliminary data on decay relationships in aspen and balsam poplar in the Lesser Slave Lake area. Results suggest that 100% of balsam poplar had evidence of decay by the age of 40 years; aspen showed such evidence by 60 years. Slower-growing trees also had a greater proportion of decay than typical growing trees. The average cull on a board foot basis was 72 and 39% for balsam poplar and aspen, respectively. (Location: 83 O)

Key words: Forest-damage agents, aspen, balsam poplar, economics—fiber

Pearson, A.M. 1976. The boreal forest grizzly bear, annual report. *Can. Wildl. Serv., Edmonton, Alberta.*

A survey of grizzly bears in the Swan Hills area was conducted in 1974 and 1975. In addition to capturing bears and determining basic physical characteristics, the authors also monitored bear movements by radio-tracking. (Location: 83 J)

Key words: Wildlife distribution and diversity, wildlife-habitat assessment, furbearers

Pease, J.L.; Vowles, R.H.; Keith, L.B. 1979. Interaction of snowshoe hares and woody vegetation. *J. Wildl. Manage.* 43:43-60.

The study attempts, but does not find, a correlation between food supply and the cyclic hare population. It does find that the daily food requirements of hares in winter feeding was 300 g of woody browse, with a maximum diameter of 3 to 4 mm. (Location: 83 H)

Key words: Wildlife-habitat assessment, furbearers

Penner, D.F. 1990. Small mammals in hexazinone-treated clearcuts in mixedwood forest region of north-central Alberta. Penner and Associates Ltd., Sherwood Park, Alberta.

The effects of hexazinone on small mammals in aspen clear-cuts are investigated. The study

finds that deer mice were the most abundant of six species; the abundance, survival, and reproduction characteristics of small-mammal populations did not show any acute, subacute, or chronic toxicity effects during the first winter after stand treatment or during the three subsequent summers; chemicals were detected shortly after application (0.16 to 0.24 mg/kg metabolite B; half of the analyzed tissue samples had detectable chemicals 1 year after treatment; and no chemicals were detected during the second and third years of study. (Location: 83 L)

Key words: Forest-harvesting effects, wildlife distribution and diversity, vegetation control—chemical, small mammals

Penner and Associates Ltd. 1991. Integration of wildlife objectives with silvicultural systems in the boreal mixedwood ecoregion. Penner and Associates Ltd., Sherwood Park, Alberta.

This report reviews current forestry practices to identify research needed to integrate wildlife into mixedwood forest management. The authors advocated the need for silvicultural systems that integrate wildlife and habitat needs. (Location: Northern Alberta)

Key words: Forest-harvesting effects, forest policy, site preparation, wildlife distribution and diversity

Penner, D.F.; McCourt, K.H.; Smyth, K.E. 1980. A review and assessment of the baseline data relevant to the impacts of oil sands development on black bears in the AOSERP study area. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 65.

This report provides information on population dispersion, the potential impacts of large development projects, and population dynamics of black bear in the Alberta Oil Sands Environmental Research Program study area. It is primarily based on a review of available literature. (Location: 84 A, H; 74 D, E, L)

Key words: Environmental impacts, wildlife distribution and diversity, furbearers

Pennock, D.; Braidek, J.; Anderson, R.; Elliott, K. 1996. Characterization of the major ecosections in the Wapawekka Hills and Waskesiu

Hills ecodistricts of central Saskatchewan. Univ. Sask., Saskatoon, Saskatchewan.

The study summarizes some basic soil characteristics (such as texture, pH, bulk density, available macronutrients, and cation exchange capacity) within landscape units classified to the ecosite level. This includes a comparison of jack pine, aspen, balsam poplar, and black spruce sites. (Location: 73 H)

Key words: Soil and site conditions, biological land classification

Peters, T.W. 1981. Reconnaissance soil survey of the Brazeau Dam area. Agric. Can., Res. Branch, Alta. Inst. Pedol., Ottawa, Ontario. Rep. S-81-40.

A soil survey (1:126 720) was conducted in the Brazeau Dam area (5650 km²) of Alberta. Physical and chemical characteristics are provided for selected soil series. Soil-suitability ratings are developed for forestry, wildlife, agriculture, recreation and selected engineering uses. (Location: 83 B, G)

Key words: Soil survey, physical land classification and geology, soil and site conditions, land evaluation, wildlife-habitat assessment

Peters, T.W.; Bowser, W.E. 1956. Soil survey of the Rocky Mountain House sheet. Univ. Alta., Alta. Soil Surv., Edmonton, Alberta. Rep. 19.

Soils are classified to the series level and mapped at a scale of 1:126 720 (6640 km²). General profile descriptions are provided for each series, and chemical and physical attributes are included for selected profiles. The subgroup classification needs updating. (Location: 83 B)

Key words: Soil survey, soil and site conditions

Peterson, E.B. 1970. Methods for estimating standing crop in *Populus* forests in Alberta. Can. Dep. Fish. For., Can. For. Serv., For. Res. Lab., Calgary, Alberta. Intern. Rep. A-29.

This paper outlines the methods used in a 1968-69 field study to estimate the aboveground standing crop by tree component. These measurements include various dimensions of trees and biomass sampling. The sampled trees ranged from 2 to 32 cm in diameter at breast height. (Location: Alberta)

Key words: Growth and yield

- Peterson, E.B.; Chan, Y.-H.; Peterson, N.M. 1988a.** Biomass and nutrient content of aspen ecosystems in Alberta, Canada. Pages 119-123 in C. Granger, ed. Proc. Sixth Can. Bioenergy R & D Semin., February 16-18, 1987, Richmond, British Columbia. Elsevier Applied Sci., London, England.

This study estimates the total amount of biomass in aspen stands of different ages (15, 30, and 45 years) by plant component, and provides nutrient contents by component. Included as part of this assessment are trees, understory vegetation (herbs and shrubs), and soils (LFH and mineral horizons). (Location: 73 L, 83 I, J, O, P)

Key words: Aspen, tree-crop production, ecology, vegetation assessment

- Peterson, E.B.; Chan, Y.-H.; Peterson, N.M.; Kabzems, R.D. 1988b.** Calibration of FORCYTE-11 growth simulation model for aspen ecosystems in Alberta, Canada. Pages 151-154 in C. Granger, ed. Proc. Sixth Can. Bioenergy R & D Semin., February 16-18, 1987, Richmond, British Columbia. Elsevier Applied Sci., London, England.

This study is a sensitivity analysis of the FORCYTE-11 computer modeling system, which was developed to simulate the effects of different land-management strategies on aspen biomass production. Biomass and growth increment variables are used as output parameters to evaluate the sensitivity of the model to different variables. (Location: 73 L; 83 I)

Key words: Aspen, soil and site conditions, ecology, growth and yield

- Peterson, E.B.; Levinsohn, A.G. 1977.** Vegetation types and forest productivity, west part of Syncrude's Lease 17, Alberta. Syncrude Canada Ltd., Edmonton, Alberta. Environ. Res. Monogr. 1977-6.

The purpose of this study was to obtain baseline vegetation information on the western half of Syncrude's Canada's oil sand development lease in northern Alberta. Data were collected on the floristic composition and species abundance of eight vegetation types. Forest

productivity is quantified for each vegetation unit. Aspen was dominant in three of the eight communities types. Fire history and flooding from beaver dams were the major influences on floristic composition and vegetation patterns. (Location: 74 E)

Key words: Vegetation classification, soil and site conditions, growth and yield, soil and site productivity

- Peterson, E.B.; Levson, V.M.; Kabzems, R.D. 1982.** Upper limits of standing crop density for woody species in the prairie provinces. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-243.

Forest and nonforest stands were sampled in the boreal mixedwood and foothills zones to determine the maximum amount of biomass present in young stands (less than 10 years old). Results suggest that aspen stands (less than 5 years old) can have up to 30 t/ha of biomass. A variety of regression equations are developed for estimating dry weight by component. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Growth and yield, vegetation assessment, aspen, tree-crop production

- Peterson, E.B.; Peterson, N.M. 1992.** Ecology, management, and use of aspen and balsam poplar in the prairie provinces of Canada. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. Spec. Rep. 1.

This is an excellent monograph on aspen and balsam poplar in the prairie provinces. The report includes sections on morphology, reproduction, site and ecological relationships, diseases and pests, growth and yield, succession, and associated wildlife, as well as an extensive list of related citations. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Aspen, balsam poplar, growth and yield, ecology, soil and site productivity, forest-damage agents, wildlife distribution and diversity

- Peterson, E.B.; Peterson, N.M. 1994.** Synopsis of information on white, Engelmann, and black spruce natural regeneration in North America. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta,

Alta. Environ. Prot., Alta. Lands For. Serv., Edmonton, Alberta, and Manit. Nat. Resour., For. Branch, Winnipeg, Manitoba. Can.-Alta. and Can.-Manit. Partnership Agreements For. Rep. 112.

This report is an annotated bibliography with 563 references and a focus on the natural regeneration of spruce. Some of these references are directly applicable to boreal mixed-wood environments, while others provide potentially relevant background information. (Location: Primarily North America)

Key words: Reforestation, white spruce, black spruce, ecology, forest-harvesting effects

Peterson, E.B.; Peterson, N.M.; Kabzems, R.D. 1983. Impact of climatic variation on biomass accumulation in the boreal forest zone: selected references. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-254.

This bibliography lists literature up to 1981 on the relationship between climatic variables and growth rates of boreal tree species. A summary is provided for each article, as well as a subject index. (Location: Canada)

Key words: Forest-harvesting effects, climate and related effects, growth and yield, aspen, vegetation assessment, white spruce, balsam poplar, white birch, jack pine

Peterson, N.M. 1990. Bibliography of recent North American literature on aspen and balsam poplar to 1989, companion dBASEIV data base to Peterson and Peterson (1992). For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta.

This bibliography lists literature compiled on aspen and balsam poplar. It includes a wide range of topics taken from various North American sources. The data base is organized in a row-and-column format. (Location: Not applicable; literature review)

Key words: Aspen, balsam poplar, even-aged stand management, uneven-aged stand management, site preparation, vegetation control—chemical, vegetation control—mechanical, forest-damage agents, plant propagation, growth and yield, genetics and cellular structure

Phillips, W.E.; Beck, J.A.; Lamble, G.W. 1986. Forest economics research needs for west-central Canada. Univ. Alta., Fac. Agric. For., Dep. Rural Econ., Edmonton, Alberta. Bull. 27, and Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-281.

Based on a questionnaire, 26 areas requiring economic research are identified. The top five were economics of: integrated forest land use, regional and economic forest industry impact, forest protection, allowable-cut determinations, and timber-supply analysis modeling. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Economics—fiber, economics—nonfiber, resource planning, growth and yield, fire management and effects

Pielou, E.C.; Campbell, J.S.; Lieffers, V.J. 1986. Comparison of the structures of even-aged aspen stands in three geographic regions. Can. J. Bot. 64:122-129.

This study provides information on the growth rates of individual stems and the rates at which they self-thin in even-aged stands of northern Alberta. It also describes a dynamic model devised to simulate the demographic behavior of aspen stands. (Location: 74 D, E)

Key words: Growth and yield, even-aged stand management, aspen

Pike, R.T. 1953. Thinning aspen, Duck Mountain Forest Reserve, Manitoba. Can. Dep. Resour. Dev., For. Branch, Ottawa, Ontario. Silviculture Leaflet 89.

This paper reports preliminary results from a 1926 study that involved the removal of aspen from mixedwood stands and its effect on white spruce growth. Results suggest that tree diameter increased and mortality of white spruce decreased. (Location: 62 N)

Key words: Juvenile stand-tending, vegetation control—mechanical, growth and yield, uneven-aged stand management, aspen, white spruce

Pluth, D.J. 1986. Amelioration of subsurface horizons of Luvisolic soils through mechanical disruption. Can. For. Serv., North. For. Cent., Edmonton, Alberta.

Not available for review.

Key words: Site preparation, soil and site conditions

- Plylpec, B.; Redmann, R.E. 1984. Acid-buffering capacity of foliage from boreal forest species. Can. J. Bot. 62:2650-2653.**

This study indicates that broadleaf species, including aspen, are better buffered against acidic pollution than evergreens, especially jack pine. Leaf-tissue samples from various tree species had their lowest pH values during mid-summer. (Location: 73 B)

Key words: Pollution effects, ecology, aspen, jack pine, black spruce, white spruce

- Polster, D.F.; Watson, L.E. 1979. Vegetation classification and evaluation—Elk Island National Park. Parks Can., Calgary, Alberta.**

This report presents a vegetation classification and describes the associated ecological conditions in Elk Island National Park. The vegetation classification relies strongly on floristics, with minimal attention paid to the physiognomy of communities or the abundance of species. (Location: 83 H)

Key words: Vegetation classification, vegetation assessment, soil and site conditions

- Ponto, R.L. 1990. Bulldozer production rates and guidelines for constructing fireguards in boreal forest cover types. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta, and Alta. For. Lands Wildl., Edmonton, Alberta. Can.-Alta. For. Resour. Dev. Agreement Rep.**

This report summarizes by forest cover type the productivity rate of bulldozers in creating fireguards in the boreal forest, based on approximately 200 km of construction and 600 hours of work. It also provides guidelines for constructing fireguards by forest cover type. (Location: Alberta)

Key words: Fire management and effects

- Powell, J.M.; MacIver, D.C. 1977. A summer climate classification for the forested area of the prairie provinces using factor analysis. Fish. Environ. Can., Can. For. Serv., North. For. Res.**

Cent., Edmonton, Alberta. Inf. Rep. NOR-X-177.

Factorial analysis is used to develop a classification of summer climates in the forested and adjacent areas of the prairie provinces. The meteorological stations used in this study were distributed throughout the forest portion of Alberta, but located primarily in the southern portion of the boreal in Saskatchewan and Manitoba. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Climate and related effects

- Powell, J.M.; MacIver, D.C. 1978. Maps of selected climatic parameters for the prairie provinces, May to September, 1961-1970. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-206.**

This report presents maps of mean daily temperature, precipitation, number of days with a minimum temperature of -2.2°C and below, and water deficiency assuming a soil-moisture storage level of 100 mm for the individual summer months of May to September and for the summer season for the years 1961-1970. The majority of the data were acquired for weather stations in the forested areas in the prairie provinces. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Climate and related effects

- Powelson, R.A.; Lieffers, V.J. 1991. Growth of dormant buds on several rhizomes of *Calamagrostis canadensis*. Can. J. Plant Sci. 71:1093-1099.**

The regenerative capability of *Calamagrostis* was experimentally assessed. This report concludes that severed rhizomes are more likely to sprout buds near the apex than at their distal ends, while buds are more likely to develop near the parent plant than along the remaining portion of the rhizome. (Location: 83 P)

Key words: Vegetation control—*Calamagrostis*, ecology

- Pratt, R.H.M. 1966. Aerial spraying with 2,4-D to eliminate aspen. Pulp Pap. Mag. Can. 67(9):WR460-462.**

Results of this study indicate that aerial application of 2,4-D is effective in reducing

hardwood crown cover. Approximately 75% of the hardwoods in this study were severely damaged (i.e., top-killed). Aspen was the most severely affected, followed by white birch and balsam poplar. Aspen suckers were also killed, but 2,4-D had little effect on balsam poplar suckers. (Location: 62 K)

Key words: Vegetation control—chemical, aspen, balsam poplar, white birch

Pringle, W.L.; Elliott, C.R.; Dobb, J.L. 1973. Aspen regrowth in pastures of the Peace River region. *J. Range Manage.* 26:260–262.

In this study, methods are investigated to circumvent the cost (e.g., breaking soil, removing roots, and seedbed preparation) of converting forest land to pasture. Various types of tillage equipment are compared to assess their comparative abilities to minimize aspen sucker development. (Location: Northwest Alberta)

Key words: Vegetation control—mechanical, aspen, forest grazing

Prokopchuk, J.R.; Archibald, J.H. 1976. Land capability classification for forestry in Alberta. *Alta. Energy Nat. Resour., Alta. For. Serv., Edmonton, Alberta. Rep.* 6.

A systematic assessment was conducted from 1965 to 1973 to classify forest-land capability in Alberta. This report provides a summary of the methods used in this classification. Assessment criteria include parameters related to site and climatic conditions. (Location: Alberta)

Key words: Land evaluation, physical land classification and geology, soil and site productivity, soil and site conditions, growth and yield, white spruce, lodgepole pine

Quaite, J. 1953. Poisoning with "ammate" to eliminate aspen. *Can. Dep. North. Aff. Natl. Resour., For. Branch, Ottawa, Ontario. Silv. Leaflet.* 94.

This study determines the effects of aspen removal with ammate on white spruce growth. When applied to the stumps of 2.5-cm trees, the ammate prevented root and stump sprouting, and killed numerous adjacent aspen. The poison killed large aspen 10–15 m away from the treated stump. When ammate was applied to

larger trees, the effect was less dramatic. (Location: 83 O)

Key words: Vegetation control—chemical, growth and yield, aspen, white spruce

Quintilio, D.; Alexander, M.E.; Ponto, R.L. 1991. Spring fires in a semimature trembling aspen stand in central Alberta. *For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-323.*

The results of burning experiments are presented. The original burning occurred in 1972, and additional burning was conducted in 1978. Data are presented on the understory vegetation of unburned controls, post-1972, and post-1978 burn plots. Data are also provided on fuel supplies and burning conditions. (Location: 82 O)

Key words: Fire management and effect, vegetation assessment, aspen

Rannard, C.D. 1974. Poplar management in Manitoba. Pages 25–41 in R.W. Neilson and C.F. McBride, eds. *Poplar utilization symposium. Proc., May 23–24, 1974, Edmonton, Alberta. Can. Dep. Environ., Can. For. Serv., West. For. Prod. Lab., Vancouver, British Columbia. Inf. Rep. VP-X-127.*

This is a general overview of poplar availability and management policies in Manitoba. A brief summary of aspen use and users is also provided. The availability of aspen and other tree species is summarized by forest region and management unit. (Location: Manitoba)

Key words: Forest policy, economics—fiber, aspen, balsam poplar, jack pine, white spruce, black spruce

Raske, A.G. 1974. Hatching rates of forest tent caterpillar in the laboratory. *Environ. Can., Can. For. Serv., Ottawa, Ontario. Bi-mon. Res. Notes* 30(4):24–25.

This study determines the incubation period, larval-hatching rate, and number of larvae obtainable from egg bands of forest tent caterpillars. These variables are measured and tabulated for the 1966–1967 period. (Location: 83 G)

Key words: Forest-damage agents

Rayner, M.R. 1984. Ecological land classification and evaluation: Ram-Clearwater. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. T/11-12.

An ecological land classification (1:100 000) and a descriptive report are developed for the Ram-Clearwater study area (3500 km²). Only the easternmost portion of the area contained mixedwood forests. A general overview is provided for various environmental components such as vegetation and wildlife in the area. (Location: 83 B, C; 82 N, O)

Key words: Ecological land classification, vegetation assessment, soil and site conditions

Reeder, S.W.; Odynsky, W. 1965. Soil survey of the Cherry Point and Hines Creek area. Res. Counc. Alta., Edmonton, Alberta. Rep. 85.

A soils inventory and classification (1:190 080 scale) is developed for an area south of High Level. Profile descriptions are given for each soil series, and chemical and physical attributes are summarized for selected profiles. The soil subgroup classification requires updating. (Location: 84 D)

Key words: Soil survey, soil and site conditions

Reeder, S.W.; Odynsky, W. 1969. Reconnaissance soil survey of the Hotchkiss and Keg River area. Res. Counc. Alta., Edmonton, Alberta. Rep. 89.

A soil survey (1:190 080) was conducted in northwestern Alberta (7955 km²). This report classifies soils to the series level and describes the soils, their distribution, and their chemical and physical characteristics. Gray Luvisols were the most common soils in the area. (Location: 84 F)

Key words: Soil survey, soil and site conditions

Regier, H. 1985. Effects of municipal waste water irrigation on an aspen poplar forest. Alta. Environ., Environ. Prot. Serv., Edmonton, Alberta.

A 5-year study was conducted to determine the effects of wastewater irrigation on soil, groundwater, and aspen growth. Results indicate that irrigation had a marginal measurable

effect, but was not detrimental overall to the ecosystems. (Location: 83 H)

Key words: Environmental impact, aspen

Reid, D.E. 1974. Vegetation of the Mackenzie Valley—Part one. Vol. 3. Can. Arct. Gas Study Ltd., Calgary, Alberta. Biol. Rep.

This study provides baseline information on the vegetation ecology of the Mackenzie Valley, including physiography, landforms, and terrain types. A total of 55 terrain types characterized by 12 vegetation types are described and mapped at a scale of 1:24 000. Forest productivity was considered low compared to southern Canada. (Location: Northwest Territories)

Key words: Vegetation classification, ecological land classification, physical land classification and geology

Reid, D.E., ed. 1977. Vegetation survey and disturbance studies along the proposed Arctic Gas route. Can. Arct. Gas Study Ltd., Calgary, Alberta. Biol. Rep. 37.

A reconnaissance survey of vegetation and disturbance was completed along selected portions of the proposed Arctic Gas pipeline right-of-way. This report describes 19 plant communities in 17 physiographic areas. Plant communities are related to landforms. (Location: Alberta)

Key words: Vegetation assessment, vegetation classification, physical land classification and geology

Reid, D.E. 1986. Ecological land classification of Elk Island National Park. Parks Can., Calgary, Alberta.

A biophysical inventory of Elk Island National Park is developed with a strong emphasis on plant communities. Soil, site, and terrain conditions are summarized according to community-types. The vegetation classification is based primarily on dominant species by stratum. (Location: 83 H)

Key words: Ecological land classification, vegetation classification, soil and site conditions, physical land classification and geology

Renecker, L.A. 1986. Bioenergetics and behaviour of moose (*Alces alces*) in the aspen boreal forest. Ph.D. thesis, Univ. Alta., Edmonton, Alberta.

This study evaluates seasonal changes in diet and energy expended by moose, and moose resource-use behavior. These results are compared to those of wapiti and cattle. Willows and balsam poplar browse formed the majority of the winter diet, while aspen was commonly used during the summer. (Location: 83 H)

Key words: Wildlife distribution and diversity, wildlife-habitat assessment, ungulates

Renecker, L.A.; Hudson, R.J. 1985. Estimation of dry matter intake of free-ranging moose. J. Wildl. Manage. 49:785-792.

This study evaluates seasonal changes in the amount of feed consumed by moose. The consumption by two moose was monitored for 6-8 weeks on a 24-hour basis. During summer, intake ranged from 38 to 128 g/kg of body weight. (Location: 83 H)

Key words: Wildlife-habitat assessment, ungulates

Renecker, L.A.; Hudson, R.J. 1986. Seasonal foraging rates of free-ranging moose. J. Wildl. Manage. 50:143-147.

Foraging rates of free-ranging moose in aspen habitats are evaluated. Consumption rates increased with the increased availability of biomass, but maximum consumption rates varied seasonally. Foraging was most difficult for moose during the winter season. (Location: 83 H)

Key words: Wildlife-habitat assessment, ungulates

Rennie, D.A.; Klassen, W.A.; Fuller, G.A.; Kennett, E.H. 1985. Report of the task force on use of herbicides in forest management. Sask. Dep. Parks Renewable Resour., Saskatoon, Saskatchewan.

This study reports the conclusions of a task force that reviewed the use of herbicides in the forest industry. The task force concluded that 2,4-D or 2,4,5-T degraded within a few days after application, but Roundup had a half-life

of 60 days. Cool, moist soils can prolong degradation of these chemicals. (Location: Not applicable; literature review)

Key words: Vegetation control—chemical, soil and site conditions

Rintoul, J.; Myers, S. 1983. Avifauna of Crow Lake Candidate Ecological Reserve—observed and expected. Alta. Energy Nat. Resour., Nat. Areas Program, Edmonton, Alberta. Tech. Rep. 10.

This report consists of an annotated list of birds and a summary of their associated habitats for Crow Lake. Abundance ratings are provided for each species. (Location: 83 P)

Key words: Wildlife-habitat assessment, birds

Rivard, P.G.; Woodard, P.M.; Rothwell, R.L. 1990. The effects of water table depth on white spruce (*Picea glauca*) seedling growth in association with marsh reed grass (*Calamagrostis canadensis*) on wet mineral soil. Can. J. For. Res. 20:1553-1558.

This study examines whether the survival, growth, and nutrient content of white spruce seedlings are significantly affected by competition with marsh reed grass under simulated water table conditions on wet mineral-soil substrates. The presence of reed grass significantly affected growth of seedlings. The nutrient concentration of the white spruce foliage was significantly affected by water table depths and the presence of grass. (Location: 83 H)

Key words: Vegetation control—*Calamagrostis*, site preparation, soil and site productivity, white spruce, ecology

Roberts, W.; Lewin, V. 1979. Habitat utilization and population densities of the amphibians of northeastern Alberta. Can. Field-Nat. 93:144-154.

Herpetofauna in the Fort MacMurray area are inventoried in a variety of habitats. The study reports that they were usually found on wet upland sites in close proximity to water. Smaller populations were also found on drier upland sites (e.g., aspen, white spruce stands). (Location: 74 D, E)

Key words: Amphibians, wildlife distribution and diversity

- Roberts, T.L. 1987.** Sulfur and its relationship to carbon, nitrogen and phosphorus in a climotoposequence of Saskatchewan soils. Ph.D. thesis, Univ. Sask., Saskatoon, Saskatchewan.

Not available for review. (Location: Saskatchewan)

Key words: Ecology, soil and site conditions

- Robertson, S.L. 1994.** Effects of harvesting methods on the phytosociology of a boreal mixedwood forest community. M.Sc.F. thesis, Lakehead Univ., Thunder Bay, Ontario.

Not available for review. (Location: Manitoba)

Key words: Forest-harvesting effects, vegetation assessment

- Roed, M.A. 1970.** Surficial geology Edson, NTS 83 F. Res. Counc. Alta., Edmonton, Alberta. Alta. Geol. Surv. Maps 33.

Surficial deposits were mapped on the 83 F map sheet at a scale of 1:250 000. A brief description, focusing on textural composition, is provided on the map for the broadest types of surficial materials. (Location: 83 F)

Key words: Physical land classification and geology

- Rolley, R.; Keith, L. 1979.** A review of moose habitat requirements. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Proj. TF.1.1.

This paper reviews seasonal habitat preferences by moose. It includes factors such as food quality, snow depth, escape cover, and the occurrence of mineral licks as they related to the distribution of moose. Site with willows tended to be the most popular. (Location: Not applicable; literature review)

Key words: Wildlife-habitat assessment, wildlife distribution and diversity, ungulates

- Rolley, R.E.; Keith, L.B. 1980.** Moose population dynamics and winter habitat use at Rochester, Alberta, 1965-79. Can. Field-Nat. 94:9-18.

Moose population growth and habitat use are evaluated for a 13-year period. Moose selected treed muskegs and upland aspen stands less than 10 m in height, and tended to avoid agricultural clearings, roads, and dwellings. (Location: 83 H)

Key words: Wildlife-habitat assessment, wildlife distribution and diversity, ungulates

- Ross, M.S.; Flanagan, L.B.; La Roi, G.H. 1986.** Seasonal and successional changes in light quality and quantity in the understory of boreal forest ecosystems. Can. J. Bot. 64:2792-2799.

This study describes and interprets the patterns of temporal and spatial variation in light quality and understory vegetation in eight forest types. In the mixedwood forests, red:infrared light ratios and photosynthetically active radiation values declined rapidly in May and June during the time of leaf expansion, and increased with leaf senescence in September. The differences in light regime in early and late successional forests could have important implications for phytochrome-controlled development and succession in understory plant species. (Location: 83 O)

Key words: Climate and related effects, vegetation assessment, ecology

- Ross, M.S.; La Roi, G.H. 1984.** Structural dynamics of boreal forest ecosystems on three habitat types in the Hondo-Lesser Slave Lake area of north central Alberta in 1983. Alta. Environ., Res. Manage., Edmonton, Alberta. RMD-80/35A.

The phenological and successional changes on eight study sites in the Hondo-Lesser Slave Lake area are summarized, based on 3 years of data. One of the studied habitat types was dominated by aspen-white spruce vegetation. Information is also provided on meteorological conditions, light quality, and seasonal variation in avifauna. (Location: 83 O)

Key words: Vegetation assessment, ecology, climate and related effects, birds

- Rostad, H.W.P.; Ellis, J.G. 1972.** The soils of the provincial forest in the St. Walburg map area (73F). Univ. Sask., Sask. Inst. Pedol., Saskatoon, Saskatchewan. Publ. SF2.

A soil survey (1:126 720 scale) was developed for a 4000-km² area south of Meadow Lake. Profile descriptions and physical and chemical data are provided for selected soil series. Soil-capability ratings are included for agriculture and forestry. (Location: 73 F)

Key words: Soil survey, soil and site conditions, land evaluation

Rothwell, R.L. 1978. Watershed management guidelines for logging and road construction in Alberta. *Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-208.*

This report provides guidelines for harvesting operations and road construction to ensure protection of water resources. The guidelines are intended to help reduce erosion, sedimentation, and deterioration of water quality. Numerous examples of poor road design are provided. (Location: Alberta)

Key words: Forest-harvesting effects, environmental impacts, hydrology, erosion assessment

Rowan, W.; Keith, L.B. 1956. Reproductive potential and sex ratio of snowshoe hare in northern Alberta. *Can. J. Zool.* 34:273-281.

This study finds that the average litter size of snowshoe hare was 3.8, with a modal size of 4 and a range of 1-7. The average number of litters per year was 2.75; thus, the annual reproductive potential was 10.5 young per female. (Location: 74 D)

Key words: Wildlife distribution and diversity, furbearers

Rowe, J.S. 1955. Factors influencing white spruce reproduction in Manitoba and Saskatchewan. *Can. Dep. North. Aff. Natl. Resour., For. Branch, Ottawa, Ontario. Tech. Note 3.*

This report summarizes general site conditions required for white spruce establishment. These factors include seed germination, substrates, and associated understory species. Rowe advocates the use of fire as a site-preparation technique. This article is now considered dated relative to current knowledge. (Location: Saskatchewan, Manitoba)

Key words: Soil and site conditions, ecology, fire management and effects, white spruce

Rowe, J.S. 1956a. Use of undergrowth plant species in forestry. *Ecology* 37:461-473.

Here, Rowe outlines a method of using undergrowth plant species as indicators of forest-site types in the southern boreal forest. A vegetation table presents the relationship of vegetation strata to forest-moisture class. Another diagram illustrates the cover abundance of undergrowth strata in mature stands of poplar, poplar-spruce, and spruce. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Vegetation assessment, soil and site conditions, aspen, white spruce

Rowe, J.S. 1956b. Vegetation of the southern boreal forest in Saskatchewan and Manitoba. *Ph.D. thesis, Univ. Manit., Winnipeg, Manitoba.*

This study represents an early investigation of the plant communities and their associated site conditions in the boreal mixedwood zone of central Saskatchewan and Manitoba. The floristic composition and average percentage cover are described for several mixedwood plant associations as well as successional trends. (Location: Saskatchewan, Manitoba)

Key words: Vegetation classification, vegetation assessment, soil and site conditions, soil and site productivity, ecology

Rowe, J.S. 1972. Forest regions of Canada. *Can. Dep. Fish. Environ., Can. For. Serv., Ottawa, Ontario. Publ. 1300.*

Eight forest regions and various forest sections in Canada are mapped and described in terms of location, dominant trees, and associated terrain conditions. In addition to a 1:7 500 000-scale map, small maps are included within the text that depicted the location of forest sections. This work has long-served as the description of record for Canada's forest regions. (Location: Canada)

Key words: Ecological land classification, soil and site conditions

Rowe, J.S. 1983. Concepts of fire effects on plant individuals and species. *Pages 133-154 in*

R.W. Wein and D.A. MacLean, eds. *The role of fire in northern circumpolar ecosystems*. Proc., October 22–24, 1979, Fredericton, New Brunswick. John Wiley and Sons, Chichester, England.

The survival adaptations of boreal forest plants are reviewed and classified as invaders, evaders, avoiders, resisters, and endurers. Selected species in each category are also summarized according to moisture regime (i.e., dry to moist). The authors conclude that some species have more than one adaptation method for surviving fire. (Location: Not applicable; literature review)

Key words: Fire ecology; soil and site conditions, vegetation assessment

Rowe, J.S.; Scotter, G.W. 1973. Fire in the boreal forest. *Quat. Res.* 3:444–464.

This work reviews the general ecology and role of fire in boreal forest communities. Included in the discussion are the causes of fire, the effects of fire on community composition, postfire recovery, and nutrient cycling, fuels, costs and benefits to wildlife. (Location: Canada)

Key words: Fire ecology, vegetation assessment, ecology, wildlife distribution and diversity

Roy, L.D.; Stelfox, J.B.; Nolan, J.W. 1995. Relationships between mammal biodiversity and stand age and structure in aspen mixedwood forests in Alberta. Pages 159–189 in J.B. Stelfox, ed. *Relationships between stand age, stand structure, and biodiversity in aspen mixedwood forests in Alberta*. Alta. Environ. Cent., Vegreville, Alberta, Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Alta. Land For. Serv., Edmonton, Alberta.

This study compares the diversity of mammal species with three age classes of aspen ($n = 12$) stands and selected structural characteristics of the stands. The data indicate that older and younger stands had greater species diversity than intermediately aged stands. Greater species diversity is associated with greater stand complexity (e.g., greater height, canopy composition, snags, downed dead woody material, and understory vegetation stratification). The authors suggest caution in applying the results

due to a limited sampling intensity for wildlife. (Location: 73 L; 83 P)

Key words: Wildlife distribution and diversity, small mammals, furbearers, ungulates, aspen

Rusch, D.H.; Keith, L.B. 1971. Ruffed grouse-vegetation relationships in central Alberta. *J. Wildl. Manage.* 35:417–429.

This study shows that 85% of all observed ruffed grouse were recorded in aspen woods. Male ruffed grouse selected drumming sites that were surrounded by suitable vegetation; however, no correlations were found between the length of time a male occupied a drumming site and any characteristics of the surrounding vegetation. (Location: 83 I)

Key words: Birds, aspen, wildlife distribution and diversity, vegetation assessment

Rusch, D.A.; Reeder, W.G. 1978. Population ecology of Alberta red squirrels. *Ecology* 59:400–420.

The authors describe temporal changes and spatial differences in the population structure and densities of red squirrels in black spruce, jack pine, and aspen stands. Red squirrels were less abundant in aspen stands, based on population densities of 0–99 animals per 100 ha, which is low compared to coniferous stands. After fall dispersal, virtually all squirrels occupying aspen habitats were juveniles. Annual survival was highest in spruce and lowest in aspen. (Location: 83 H)

Key words: Wildlife distribution and diversity, vegetation assessment, furbearers, black spruce, jack pine, aspen

Russell, W.B. 1986. Classification of cover types for wildlife habitat inventory in Alberta. Alta. For. Lands Wildl., Fish Wildl. Div., Edmonton, Alberta.

A cover type classification was designed specifically for Alberta's wildlife habitat inventory and mapping at intermediate scales (1:100 000 to 1:250 000). Cover types were differentiated on the basis of stand physiognomy and structure. A total of 131 cover type units are recognized. (Location: Alberta)

Key words: Vegetation classification, wildlife-habitat assessment

Russell, W.; Annas, R.; Knapik, L. 1984. Potential natural vegetation data base for Alberta habitat subregions. Alta. Energy Nat. Resour., Fish Wildl. Div., Edmonton, Alberta.

Vegetation types are summarized for 12 wildlife-habitat regions of Alberta, based on existing literature. For each vegetation type, the following information is provided: physiognomic type, associated species, moisture regime, soils, landforms, authors' comments, and sources. (Location: Alberta)

Key words: Wildlife-habitat assessment, vegetation assessment, soil and site conditions

Santo, M. 1984. Pedogenesis of Luvisolic soils in east-central Saskatchewan. Ph.D. thesis, Univ. Sask., Saskatoon, Saskatchewan.

Soil profiles from three different mixedwood sites in the boreal forest are compared in terms of their development. Although similar processes influenced soil profile development on the three sites, site conditions (e.g., moisture regime) affected how it developed. (Location: 73 H)

Key words: Soil and site conditions

Saskatchewan Power Corporation. 1977. Proposed Nipawin hydroelectric project—environmental assessment. Sask. Power Corp., Regina, Saskatchewan.

An overview of the natural resources is presented for an area along the Nipawin River upstream of Nipawin as part of an environmental impact assessment study. Vegetation, wildlife, recreation, and forestry resources are reviewed. (Location: 63 E)

Key words: Vegetation assessment, land evaluation, wildlife distribution and diversity, environmental impacts

Sauder, E.A. 1992. Timber-harvesting techniques that protect conifer understory in mixedwood stands: case studies. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta, and Alta. For. Lands Wildl., Alta. For. Serv., Edmonton, Alberta. Can.-Alta. Partnership Agreement For. Rep.

Various approaches to harvesting are reviewed and assessed for their impact (seedlings

and cost) on coniferous understory vegetation in aspen and mixedwood stands. The author concludes that 40–60% of coniferous understory could be protected with minimal effort. Additional protection above this level can be accomplished with proper planning, use of appropriate equipment, and staff training. Feller-bunchers and grapple skidders protected conifers better than Scandinavian equipment. (Location: 83 B, F, J)

Key words: Forest-harvesting effects, understory protection, white spruce

Scheelar, M.D.; Macyk, T.M. 1972. Reconnaissance soil survey of the Mount Watt and Fort Vermilion area. Res. Coun. Alta., Edmonton, Alberta. Rep. 92.

A soil survey (19 100 km²) at the series level was conducted in the High Level–Fort Vermilion area (1:126 720 scale). Profile descriptions are given for each series and physical and chemical characteristics are summarized for selected profiles. Agricultural capability and soil suitability for timber production are reviewed. (Location: 84 J, K)

Key words: Soil survey, soil and site productivity, land evaluation

Scheelar, M.D.; Odynsky, W. 1968. Soil survey of the Grimshaw and Notikewan area. Res. Coun. Alta., Edmonton, Alberta Rep. 88.

This paper is a soils inventory and classification (1:190 080 scale) for an area near Peace River, Alberta. Profile descriptions are given for each soil series, and chemical and physical attributes are summarized for selected profiles. The paper's soil subgroup classification needs to be updated. (Location: 84 C)

Key words: Soil survey, soil and site conditions

Schewe, A.M.; Stewart, J.M. 1986. Twig weight–diameter relationships for selected browse species in the Duck Mountain Forest Reserve. Can. J. For. Res. 16:675–680.

This work is part of a larger study that examines moose, elk, and deer browse consumption in clear-cutting located in the Duck Mountain area of Manitoba. The study determines the best time of year to collect twigs. Results reveal that seasonal variation in twig weight–diameter

relationships is great. The authors recommend that twigs should be collected during dormancy in winter or during their period of growth cessation in late summer. (Location: 62 N)

Key words: Wildlife-habitat assessment, ungulates, vegetation assessment, forest-harvesting effects

- Schieck, J.; Nietfeld, M. 1995. Bird species richness and abundance in relation to stand age and structure in aspen mixedwood forests in Alberta. Pages 115-157 in J.B. Stelfox, ed. Relationship between stand age, stand structure, and biodiversity in aspen mixedwood forests in Alberta. Alta. Environ. Cent., Vegreville, Alberta, Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Alta. Land For. Serv., Edmonton, Alberta.

The abundance of terrestrial birds is compared in three different age classes of aspen stands (12 stands ranging from 23 to 146 years old). Results indicate that certain birds are associated with each age class, although overlaps in occurrence did occur. Older stands tended to have the greatest diversity, possibly due to a greater range of resources (i.e., larger live trees, more snags, greater structural diversity) than younger stands. (Location: 73 L; 83 P)

Key words: Wildlife distribution and diversity, birds, ecology, aspen

- Schieck, J.; Roy, L.D. 1995. Changes in vertebrate communities in relation to variation in forest community attributes: A comparison of bird and mammal communities. Pages 241-261 in J.B. Stelfox, ed. Relationships between stand age, stand structure, and biodiversity in aspen mixedwood forests in Alberta. Alta. Environ. Cent., Vegreville, Alberta, Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Alta. Land For. Serv., Edmonton, Alberta.

Vertebrate species (birds, small mammals, furbearers, ungulates, amphibians) presence and abundance are compared with aspen stand age classes and general stand characteristics. Stand variables accounted for less than 25% of the variance in species abundance, based on canonical correspondence analysis. This study

is a composite analysis of wildlife that had been previously analyzed as individual wildlife groups. See Roy et al. 1995; Schieck and Nietfeld 1995; Schieck et al. 1996; Stelfox et al. 1995. (Location: 73 L; 83 P)

Key words: Wildlife distribution and diversity, small mammals, furbearers, ungulates, birds, amphibians, aspen

- Schieck, J.; Roy, L.D.; Stelfox, J.B. 1996. Variation in vertebrate communities among three successional stages of aspen-dominated boreal mixedwood forest in Alberta. Pages 86-91 in C.R. Smith and G.W. Crook, comp. Advancing boreal mixedwood management in Ontario. Proc. Workshop, October 17-19, 1995, Sault Ste. Marie, Ontario. Nat. Resour. Can., Can. For. Serv., Great Lakes For. Cent., Sault Ste. Marie, Ontario, and Ont. Minist. Nat. Resour., Sault Ste. Marie, Ontario.

- Schmidt, M.G.; Macdonald, S.E.; Rothwell, R.L. 1996. Impact of harvesting and mechanical site preparation on soil chemical properties of mixed-wood boreal forest sites in Alberta. Can. J. Soil Sci. 74:531-540.

This study finds that harvesting results in a forest floor with a high C/N ratio and a reduced nutrient concentration, while mechanical site preparation relative to untreated areas results in a reduction in available nitrogen and phosphorus, and increased soil pH and base saturation. (Location: 83 J, K)

Key words: Site preparation, soil and site conditions, forest-harvesting effects

- Schneider, B.B. 1988. Harvesting northern mixedwood forests in Alberta. Pages 110-113 in J.K. Samoil, ed. Management and utilization of northern mixedwoods. Proc. Symp., April 11-14, 1988, Edmonton, Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-296.

This paper identifies some of the concerns and issues associated with mixedwood forest harvesting, which include harvesting effects, decay, reforestation, and economics. The discussion is followed by a summary of the types of actions being taken to deal with these problems. (Location: 83 L)

Key words: Forest-harvesting effects, reforestation, economics—fiber, aspen

Schultz, R.; O'Leary, D.; Downing, D. 1986. Peace River corridor recreation study. Alta. For. Lands Wildl., Edmonton, Alberta.

An area along the Peace River from the British Columbia border to the town of Peace River was surveyed for potential recreational sites. Site-suitability ratings are developed for various uses such as campgrounds, picnic areas, building sites, and sources of sands and gravel. (Location: 83 M, N; 84 C, D)

Key words: Recreation, land evaluation

Searing, G.F. 1979. Distribution, abundance, and habitat associations of beavers, muskrat, mink, and river otters in the AOSERP study area, northeastern Alberta. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 73.

This report is a synthesis of available literature on beaver, muskrat, mink, and river otter in terms of habitat requirements. In addition, the species' population sizes, distribution, and habitat uses in the Alberta Oil Sands Research Program area are evaluated. (Location: 74 D, E)

Key words: Wildlife-habitat assessment, wildlife distribution and diversity, furbearers

Semenchuk, G.P., ed. 1992. The atlas of breeding birds of Alberta. Fed. Alta. Nat., Edmonton, Alberta.

This monograph is an overview of the 270 breeding birds that occur in Alberta. Each summary includes information on the species' rarity status, distribution, and habitat requirements. Occurrence maps are provided for each species. (Location: Alberta)

Key words: Wildlife distribution and diversity, birds

Shoup, J.M. 1970. Effect of slash on aspen regeneration (winter and summer cuts), Hudson Bay, Saskatchewan. Can. Dep. Fish. For., Can. For. Serv., For. Res. Lab., Winnipeg, Manitoba. Intern. Rep. MS-114.

This study determines the effects of unmerchantable residual overstory trees and logging

slash on the restocking of harvested aspen stands. Results suggest that aspen regeneration was abundant on both winter and summer cut areas, and under all slash conditions. Slash can somewhat reduce suckering, but does not seem to affect the level of stocking. After four growing seasons, there was no apparent reduction in numbers of density classes. (Location: 63 E)

Key words: Aspen, reforestation, uneven-aged stand management, forest-harvesting effects, site preparation

Shoup, J.M.; Nairn, L.D.; Pratt, R.H.M. 1968. Trembling aspen bibliography. Can. For. Serv., For. Res. Lab., Winnipeg, Manitoba. Liaison Serv. Note MS-L-3.

This bibliography on aspen includes disease, insects, wildlife aspects, management, silviculture, and environment prior to 1968 for Canada and the United States. A subject index lists the locations of relevant articles. (Location: Not applicable; literature review)

Key words: Aspen, even-aged stand management, uneven-aged stand management, site preparation, forest-damage agents, forest-harvesting effects, juvenile stand-tending, growth and yield, economics—fiber, wildlife-habitat assessment, fire management and effects, climate and related effects

Sidhu, S.S. 1965. Response of plant species to grazing in the forest regions of Saskatchewan. M.Sc. thesis, Univ. Sask., Saskatoon, Saskatchewan.

The study compares forested, cleared, and seeded areas. Results suggest that the percentage of decreaser plants was highest in seeded and lowest in forested habitats, and increasers were most abundant in forested and least abundant in seeded areas. Most forest forbs except *Lathyrus* increased as a result of grazing, but decreased in cleared and seeded habitats. (Location: Saskatchewan)

Key words: Forest grazing, vegetation assessment

Sidhu, S.S.; Feng, J.C. 1991. Environmental impacts of vegetation management by mechanical and chemical (Hexazinone) methods including residue chemistry. For. Can., Northwest Reg., North. For. Cent., Edmonton,

Alberta, and Alta. For. Lands Wildl., Alta. For. Serv., Edmonton, Alberta. Can.-Alta. For. Resour. Dev. Agreement Rep.

An experimental study and monitoring program was conducted to evaluate the effects of chemical and mechanical site preparation methods on the regrowth of aspen following clear-cutting. Extensive work was done on herbicides' effects and residues in the soil and vegetation. (Location: 83 L)

Key words: Vegetation control—chemical, vegetation control—mechanical, site preparation, vegetation assessment, soil and site conditions, pollution effects, aspen

Sidhu, S.S.; Feng, J.C. 1993. Hexazinone and its metabolites in boreal forest vegetation. *Weed Sci.* 41:281-287.

The herbicide chemical hexazinone was monitored for 2 years to determine how long it occurred in boreal forest plants. Testing found that foliar concentrations peaked during the early summer (original application in the previous August), but were largely undetected during the following summer. (Location: 83 L)

Key words: Vegetation control—chemical, soil and site conditions, pollution effects

Sidhu, S.S.; Feng, J.C.; Maynard, D.G. 1994. A five-year scenario of vegetation management in a mixedwood cutover in Alberta. Pages 94-119 in *Proc. Int. Conf. For. Veg. Manage.*, April 27-May 1, 1992, Auburn, Alabama. Auburn Univ., Auburn, Alabama. School For. Rep. 1993:1.

This study evaluates three chemical and mechanical site preparation techniques on the regrowth of a clear-cut mixedwood forest after several years of growth. Included are summaries of woody stem densities and changes in cover, and an assessment of chemical residues. (Location: 83 L)

Key words: Vegetation control—chemical, vegetation control—mechanical, vegetation assessment, pollution effects

Singh, T. 1982a. Biomass equations for ten major tree species of the prairie provinces. *Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-242.*

In this study, regional biomass equations are developed for 10 major tree species in the prairie provinces. These models are based on diameter and height variables, and are used to estimate stump, stem, and branch biomass. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Growth and yield, tree-crop production, aspen, balsam poplar, white birch, jack pine, lodgepole pine, white spruce, black spruce, balsam fir

Singh, T. 1982b. Weight tables for important tree species in the prairie provinces. *Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. For. Manage. Note 14.*

Equations and weight tables are developed for estimating the biomass of whole trees without foliage or fruit for prairie province tree species, including aspen, balsam poplar, lodgepole pine, jack pine, black spruce, white spruce, and balsam fir. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Growth and yield, tree-crop production, aspen, balsam poplar, white spruce, lodgepole pine, jack pine, black spruce, white birch, balsam fir

Singh, T. 1983. Weight tables for important tree species in the Northwest Territories. *Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. For. Manage. Note 27.*

Weight tables and prediction equations are developed for six major tree species ($n = 50-60$ samples per species) in the Northwest Territories. Tables provide oven-dry weights for the above-ground portion of the tree with and without foliage. (Location: Northwest Territories)

Key words: Growth and yield, tree-crop production, aspen, balsam poplar, white spruce, black spruce, jack pine

Singh, T. 1984a. Biomass equations for six major tree species of the Northwest Territories. *Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-257.*

This study models the biomass of six major tree species in the Northwest Territories. Multiple-regression models for predicting total aboveground tree, stump, and various portions

of the tree are presented. (Location: Southwestern Northwest Territories)

Key words: Growth and yield, tree-crop production, aspen, balsam poplar, white spruce, black spruce, jack pine

Singh, T. 1984b. Conversion of tree volume to biomass in the prairie provinces. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. For. Manage. Note 28.

Dry-weight tables for seven tree species are developed based on regression modeling of merchantable volumes. Weights include foliage as part of the total biomass. These estimates are based on a sampling of 45–48 trees per species. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Growth and yield, economics—fiber, tree-crop production, aspen, balsam poplar, white spruce, white birch, lodgepole pine, jack pine, black spruce, balsam fir

Singh, T. 1986. Generalizing biomass equations for the boreal forest region of west-central Canada. For. Ecol. Manage. 17:97–107.

This paper describes the procedures used to develop a single biomass regression model by species for the prairie provinces. The resulting equations are compared statistically with those developed within each province. Significant differences are found only among the aspen and balsam poplar models. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Growth and yield, tree-crop production, aspen, balsam poplar, white spruce, white birch, jack pine, black spruce, balsam fir

Singh, T. 1987. Prediction error in tree biomass regression functions for western Canada. Pages 199–208 in Estimating tree biomass regressions and their error. Proc. Workshop Tree Biomass Regression Funct. Contrib. Error For. Invent. Estimates, May 26–30, 1986, Syracuse, New York. U.S. Dep. Agric., For. Serv., Northeast. For. Exp. Stn., Broomhall, Pennsylvania. Gen. Tech. Rep. NE-117.

Regression models for predicting the biomass of several boreal tree species are developed and compared with other existing models. The models are based on diameter and height variables, and have explained variances

of approximately 98%. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Growth and yield, tree-crop production, aspen, balsam poplar, white birch, white spruce, jack pine, black spruce, balsam fir

Singh, T. 1988. Estimated downed–dead roundwood fuel volumes in central Alberta. Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-289.

This study determines the volumes of downed dead roundwood fuels in central Alberta. Regression equations are developed to estimate fuel supplies from commonly measured forest stand variables. From the study, predictive equations are derived from stand measurements, basal area, stem density, crown density, height, and age. (Location: 83 B, O; 73 M)

Key words: Growth and yield, fire management and effects

Singh, T., comp. 1988. Current applied climatological research in Alberta. Proceedings of the Workshop and 11th Annual Meeting of the Alberta Climatological Association, February 24, 1987. Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-294.

This paper summarizes various climatological studies that were in progress in 1987. A few of the studies were in the boreal forest, and include studies of evapotranspiration methods, precipitation events, wetlands, and forest microclimate. (Location: Alberta)

Key words: Climate and related effects

Singh, T.; Higginbotham, K.O. 1988. An overview of the effects of climatic change and climatic variability on forest vegetation in western Canada. Pages 255–273 in B.L. Magill and F. Geddes, eds. The impact of climate variability and change on the Canadian prairies. Proc., Symp. Workshop, September 9–11, 1987, Edmonton, Alberta. Alta. Environ., Edmonton, Alberta.

This paper reviews the anticipated ecological implications of increased atmospheric carbon dioxide from a forestry perspective. Among the factors considered are physiological responses, forest productivity and structure,

competition among species, and nutrient cycling. (Location: Canada)

Key words: Climate and related effects, pollution effects

- Singh, T.; Hillman, G.R. 1972. Reconnaissance survey of infiltration and related hydrological problems in northern Alberta and the adjacent Northwest Territories. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-29.**

The results of a 1970 reconnaissance hydrological survey in northern Alberta and in the Northwest Territories are presented. Existing and potential problems are assessed, especially those relating to infiltration, soil moisture, and water quality. Results suggest that soil freezing under saturated conditions affects infiltration capacity and overland flows, which has management implications for snowmelt floods and could have adverse effects on land clearing, resource extraction, water quality, and fish and wildlife habitat. (Location: Alberta, Northwest Territories)

Key words: Hydrology, forest-harvesting effects, climate and related effects

- Singh, T.; Kalra, Y.P. 1977. Impact of pulpwood clearcutting on stream water quality in west central Alberta. Pages 272-284 in R.H. Swanson and P.A. Logan, comp. Alberta Watershed Research Program. Proc. Symp., August 31-September 1, 1977, Edmonton, Alberta. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-176.**

This study establishes benchmark nutrient conditions in the streams of undisturbed catchments and assesses changes due to extensive clear-cutting. Results show that the water samples collected from logged catchments had increased concentrations and yields of the following inorganic constituents: Ca, Mg, Na, K, HCO_3 , SO_4 -S, Cl, NH_4 -N, NO_3 -N, NO_2 -N, and PO_4 -P. (Location: 83 F)

Key words: Forest-harvesting effects, erosion assessment, hydrology

- Singh, T.; Powell, J.M. 1986. Climatic variation and trends in the boreal forest region of western Canada. Clim. Change 8:267-278.**

This study analyzes historical meteorological reports from 1872 to 1981 for three broad boreal forest zones. One zone includes the B.18a and B.18b, and B.19 forest sections (Rowe 1972). During the period of analysis, precipitation decreased (-0.428 mm/yr) and temperatures increased ($+0.019^\circ\text{C}/\text{yr}$). (Location: Saskatchewan)

Key words: Climate and related effects

- Singh, T.; Wheaton, E.E. 1991. Boreal forest sensitivity to global warming: implications for forest management in western interior Canada. For. Chron. 67:342-348.**

This paper discusses potential implications for forestry of increased carbon dioxide levels in the atmosphere and associated climatic warming. Potential impacts include a shift in the location of the boreal forest zone, an increase in moisture stress, and reduced growth at the southern edge of the boreal forest. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Climate and related effects, pollution effects

- Skinner, D.L. 1984. Selection of winter food by beavers at Elk Island National Park. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.**

The feeding habits of beaver in Elk Island National Park are investigated. The study finds that beaver preferences decrease in the following order: young aspen to young balsam poplar and birch. Selection preference increased with increasing distance from water. Aspen, poplar, and alder were high in nutrients, but birch was low. (Location: 83 H)

Key words: Wildlife-habitat assessment, furbearers

- Smith, C.R.; Crook, G.W., comp. 1996. Advancing boreal mixedwood management in Ontario: proceedings of a workshop held October 17-19, 1995, Sault Ste. Marie, Ontario. Nat. Resour. Can., Can. For. Serv., Great Lakes For. Cent., Sault Ste. Marie, Ontario, and Ont. Minist. Nat. Resour., Sault Ste. Marie, Ontario.**

Several papers were presented at this symposium that involved the management of mixedwood forest stands and their associated resources, although most reported studies were outside the prairie provinces' mixedwood forest zone. Many of the papers provide a general overview. (Location: Canada)

Key words: Site preparation, genetics and cellular structure, forest-harvesting effects, invertebrates, amphibians, small mammals, birds, forest-damage agents

Smith, R.M. 1978. Bibliography of forest entomology research, 1927-77, Canadian Forestry Service, Prairies Region. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-212.

This is a compilation of entomology research published up to 1977. Included are approximately 850 citations for both hardwood and softwood tree species. Articles are listed alphabetically by author, with no subject index. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-damage agents

Smith, S. 1989. What did you expect? For. Chron. 65:28-39.

The author describes Weyerhaeuser Canada's experience with mixedwood forest stands and its approach to mixedwood management in its lease area in Saskatchewan. The author views hardwoods as having equal value to softwoods and, in some cases, greater value. (Location: Saskatchewan)

Key words: Tree-crop production, economics—fiber

Smithers, L.A. 1959. Some aspects of regeneration silviculture in spruce-aspen stands in Alberta. Can. Dep. For. Rural Dev., Can. For. Serv., Res. Branch, Ottawa, Ontario. Monogr. 59-5.

This study discusses how scarification might improve spruce regeneration. Results indicate that the time of scarification significantly affects white spruce regeneration. Aspen suckering was more of a problem on undisturbed than on scarified sites. (Location: 83 O)

Key words: Site preparation, vegetation control—mechanical, aspen, white spruce

Spence, J.R.; Langor, D.W. 1994. Effects of forestry practices on biodiversity of the litter-dwelling beetles in aspen forests. Alta. For. Dev. Res. Trust, Edmonton, Alberta.

The abundance and diversity of ground beetles are assessed in six different boreal mixedwood forest areas. The fauna of these areas were dominated by similar species. The authors find that diversity of ground beetles was low in young, clear-cut stands compared to older, fire-origin stands. (Location: 73 L; 83 B, O; 84 C)

Key words: Forest-harvesting effects, invertebrates

Spence, J.R.; Langor, D.W.; Niemelä, J.; Cárcamo, H.A.; Currie, C.R. 1996. Northern forestry and carabids: the case for concern about old-growth areas. Ann. Zool. Fennici 33:173-184.

This study compares the beetle populations of mature forest and clear-cut stands. The study finds that diversity increased due to an increase in habitat generalists and open-habitat specialists. The authors expect a decline in old-growth specialists, with clear-cutting because distances between suitable residual stands will be too great to maintain the populations. (Location: Alberta)

Key words: Ecology, invertebrates, forest-harvesting effects

Stelfox, H.A. 1981. Ecological land classification: Red Deer-James. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. T/11-8.

An ecological land classification (1:100 000) was prepared for the upper portion of the Red Deer and James River basin (2673 km²). Vegetation, soils, landform, and climatic zonation are included in the analysis, and summaries are provided on various wildlife groups. (Location: 82 O)

Key words: Ecological land classification, vegetation assessment, wildlife distribution and diversity

Stelfox, J.B. 1989. A selected bibliography of research and management of Alberta's native ungulates. Alta. For. Lands Wildl., Edmonton, Alberta.

This bibliography contains approximately 2200 citations of work on Alberta ungulates from 1940 to 1988. Among the topics included are life histories, status and management, land-use interactions and conflicts, and habitat-classification and evaluation techniques. (Location: Alberta)

Key words: Ungulates, wildlife distribution and diversity

- Stelfox, J.B.; Peleshok, L.; Nietfeld, M. 1991. A selected bibliography of research, management, and biology of Alberta's native ungulates. Alta. Environ. Cent., Vegreville, Alberta. AECV 92-B1.**

This bibliography is divided into 37 categories ranging from the biological and physiological aspects of ungulates to habitat and population considerations. Within each category, citations are arranged in alphabetical order. Approximately 2400 citations are included, covering work from 1940 to 1991. (Location: Not applicable; literature review)

Key words: Ungulates, fire management and effects, forest management and effects, wildlife-habitat assessment, wildlife distribution and diversity

- Stelfox, J.B.; Roy, L.D.; Nolan, J. 1995. Abundance of ungulates in relation to stand age and structure in aspen mixedwood forests in Alberta. Pages 191-210 in J.B. Stelfox, ed. Relationships between stand age, stand structure, and biodiversity in aspen mixedwood forests in Alberta. Alta. Environ. Cent., Vegreville, Alberta, Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Alta. Land For. Serv., Edmonton, Alberta.**

This study uses a variety of survey methods to evaluate whether ungulate abundance was different among three different age classes (12 individual stands 23 to 146 years old) of aspen. White-tailed deer were found to be the most abundant species, and occurring most frequently during the winter seasons in older aspen stands where larger trees occurred, shrub species density was greater, and a greater abundance of snags and coarse woody material occurred. Assessment of moose abundance was complicated by hunting effects; moose tended

to occur during winter in younger stands where high densities of shrubs and small trees occurred. (Location: 73 L; 83 P)

Key words: Wildlife distribution and diversity, ungulates, aspen

- Stelfox, J.G. 1981. Effects on ungulates of clear-cutting in western Alberta: the first 25 years. Environ. Can., Can. Wildl. Serv., Edmonton, Alberta.**

This study looks at three clear-cut forest types (white spruce, lodgepole pine and aspen). All clear-cut sites received only moderate use by big-game animals during the first 6 years after logging. Winter use was nonexistent because of snow depth. Between 6 and 12 years, both summer and winter use increased substantially due to increased abundance of browse. By the ninth year, big game used scarified sites more than unscarified sites. (Location: 83 F)

Key words: Forest-harvesting effects, wildlife distribution and diversity, wildlife-habitat assessment, site preparation, ungulates

- Stelfox, J.G. 1984. Effects of clear-cut logging and scarification on wildlife habitats in west-central Alberta. Environ. Can., Can. Wildl. Serv., Edmonton, Alberta.**

This paper reviews the effects of clear-cutting 27 years after logging. The degree of big-game use was strongly influenced by the availability of hiding and thermal cover. The early stages of stand re-establishment resulted in increased use of by deer and elk during summer, but winter use was limited for the first 25-30 years in spruce and mixedwood stands. Unscarified mixedwood stands supported higher densities of big game, furbearers, and other species more than scarified stands during the first 27 years after logging. (Location: 83 F)

Key words: Forest-harvesting effects, site preparation, wildlife-habitat assessment, wildlife distribution and diversity, ungulates, furbearers, small mammals

- Stelfox, J.G. 1988. Forest succession and wildlife abundance following clear-cut logging in west-central Alberta. Can. Wildl. Serv., Edmonton, Alberta.**

This study suggests that wildlife use of cut-over areas varies by species and time since cutting. Unscarified cutblocks, however, had greater use by wildlife than scarified cut blocks, and winter use on cutblocks was less than in coniferous stands. The early stages of forest regeneration encouraged species associated with herb and low-shrub habitats. (Location: 83 F)

Key words: Forest-harvesting effects, wildlife-habitat assessment, wildlife distribution and diversity, vegetation assessment, ungulates

Stelfox, J.G.; Lynch, G.M.; McGillis, J.R. 1976. Effects of clearcut logging on wild ungulates in the central Alberta foothills. *For. Chron.* 52:65-70.

This study determines the impact of white spruce logging on postharvest ungulate use, and the effects of scarification of logging areas on the carrying capacity of big-game range. Results indicate that unscarified areas provide more browse and cover than scarified areas. In logged areas, poplar species were 24% more abundant on scarified areas than on unscarified areas. Observed numbers of big game 17 years after logging and scarification were much lower than expected, based on carrying-capacity estimates. (Location: 83 F)

Key words: Forest-harvesting effects, wildlife distribution and diversity, wildlife-habitat assessment, vegetation assessment, site preparation, ungulates

Stelfox, J.G.; Telfer, E.S.; Lynch, G.M. 1973. Effects of logging on wildlife. *Fish Game Sports* 1-4.

The temporal impacts of logging on wildlife in the Alberta foothills are examined. The authors claim that properly managed logging will enhance wildlife habitat by creating a diversity of forest age classes that would provide both food and shelter. No evidence exists to show that any species was being threatened. (Location: Western Alberta)

Key words: Forest-harvesting effects, wildlife distribution and diversity, wildlife-habitat assessment, ungulates

Stelter, D.E. 1985. Application of the JABOWA growth stimulator to white spruce-trembling

aspen stands in Alberta. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

A forest growth model JABOWA is modified for application to Alberta's mixedwood boreal forests. The author concludes that the revised model produces results (basal area, species frequency, diameter) similar to measured values. (Location: Alberta)

Key words: Growth and yield, white spruce, aspen

Steneker, G.A. 1963. Results of a 1936 release cutting to favour white spruce in a 50-year-old white spruce-aspen stand in Manitoba. *Can. Dep. For., For. Res. Branch, Ottawa, Ontario. Publ.* 1005.

A mixedwood stand that had been thinned 30 years earlier by removing aspen and jack pine was re-examined. Results indicate that white spruce volume doubled compared to the control. The more intensive thinning resulted in greater volumes of production. (Location: Manitoba)

Key words: Uneven-aged stand management, vegetation control—mechanical, juvenile stand-tending, growth and yield, aspen, white spruce

Steneker, G.A. 1964. Ten-year results of thinning 14-, 19- and 23-year-old aspen to different spacings. *Can. Dep. For., For. Res. Branch, Ottawa, Ontario. Publ.* 1038.

Three different ages of young aspen were thinned to three different densities. A 3.6-m spacing was found best to maximize volumes, while 2.4-m spacings were best for cord wood. Total wood-volume increment declined with tree spacings greater than 2.4 m. (Location: 62 K)

Key words: Juvenile stand-tending, growth and yield, uneven-aged stand management, vegetation control—mechanical, aspen, white spruce

Steneker, G.A. 1966. Thinning aspen, Turtle Mountain Forest Reserve. *Can. Dep. For., For. Res. Lab., Winnipeg, Manitoba. Intern. Rep.* MS-25.

This study determines the efficacy of thinning an 11-year-old aspen stand to increase individual tree increment so that larger trees could be harvested at rotation age. Eighteen

years after the stand had been thinned, it was determined that strip-thinning had been unsuccessful in increasing the productivity and growth of individual trees. (Location: 62 F)

Key words: Juvenile stand-tending, growth and yield, vegetation control—mechanical, aspen, white spruce

Steneker, G.A. 1967. Growth of white spruce following release from trembling aspen. Can. Dep. Rural Dev., For. Branch, Ottawa, Ontario. Publ. 1183.

The aspen overstory of eight mixedwood stands was removed as an experiment to determine the effects on white spruce. After 10 years, diameter increased, height increment doubled, and volume increased 60% relative to the controls. (Location: Saskatchewan, Manitoba)

Key words: Uneven-aged stand management, vegetation control—mechanical, growth and yield, aspen, white spruce, juvenile stand-tending

Steneker, G.A. 1969a. Multiple thinning in fourteen-year-old poplar, Porcupine Provincial Forest, Saskatchewan. Can. Dep. Fish. For., For. Branch, For. Res. Lab., Winnipeg, Manitoba. Inf. Rep. MS-X-17.

This study was conducted to determine what stand density by age promotes the best increment and volume production. Results indicate that the level of stocking required to give maximum volume production was higher than that required to produce maximum diameter increment. (Location: 63 C)

Key words: Growth and yield, aspen, juvenile stand-tending

Steneker, G.A. 1969b. The effect of scarification upon the development of residual spruce trees in a partially cut white spruce trembling aspen stand. Can. Dep. Fish. For., For. Branch, For. Res. Lab., Winnipeg, Manitoba. Inf. Rep. MS-X-14.

This paper examines the results of scarification on residual white spruce 20 years after selective logging. The data suggest that scarification did not have a major effect on young white spruce, and could be done as close as 1–1.3 m from tree stem, but the other sides

should not be disturbed within 8 m. (Location: Not specified)

Key words: Site preparation, white spruce, vegetation control—mechanical

Steneker, G.A. 1972. Size and suckering of trembling aspen (*Populus tremuloides* Michx.) clones in Manitoba. Ph.D. thesis, Univ. Mich., Ann Arbor, Michigan.

This study investigates the size and extent of clonal intermixing, examines the effects of temperature and apical growth on suckering, and assesses the possibility of using leaf characteristics to identify the source clone of suckers. The author concludes that fire plays an important role in determining clone size. (Location: 62 K)

Key words: Ecology, fire ecology, climate and related effects, aspen, plant propagation

Steneker, G.A. 1973. The size of trembling aspen (*Populus tremuloides* Michx.) clones in Manitoba. Can. J. For. Res. 3:472–478.

This study determines the size of aspen clones in two areas within Manitoba, and where possible, relates this to site conditions; and points out the problems of getting accurate inventory data when aspen clones are large. Differences in site factors do not seem related to clone size. The conclusions suggest that to obtain sufficient information on interclonal variation in growth, a large inventory of clones must be undertaken. (Location: 62 K)

Key words: Aspen, genetics and cellular structure, growth and yield, soil and site conditions

Steneker, G.A. 1974a. Factors affecting the suckering of trembling aspen. For. Chron. 50:32–34.

This study assesses the importance of the apical dominance effect and temperature upon sucker formation on aspen roots. Results suggest that apical dominance primarily controls suckering. Once this effect has been broken, increased soil temperature promotes suckering. Recommendations are made for management of aspen. (Location: 62 K)

Key words: Aspen, soil and site conditions, plant propagation

Steneker, G.A. 1974b. Selective cutting to release white spruce in 75 to 100-year-old white spruce-trembling aspen stands, Saskatchewan. *Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-121.*

This study finds that a reduction in the density of stands 70+ years old (mostly aspen) has little effect on the productivity of larger white spruce. About 14% of the diameter increment variation is attributed to the size and distance from adjacent trees. (Location: 73 J)

Key words: White spruce, growth and yield, uneven-aged stand management, competition analysis

Steneker, G.A. 1974c. Thinning of trembling aspen (*Populus tremuloides* Michaux) in Manitoba. *Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-122.*

Aspen stands thinned 21–23 years earlier are evaluated for growth. Results show that thinning increases diameter at breast height, but also results in a decrease in total volume. Thinning spacings ranged from 1.5 to 3.6 m. (Location: 62 F, K)

Key words: Aspen, juvenile stand-tending, growth and yield

Steneker, G.A. 1976. Guide to the silvicultural management of trembling aspen in the prairie provinces. *Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-164.*

This paper discusses various aspects of aspen management such as regeneration, stand development, harvesting, disease and decay, stand-tending, stand improvement, control of aspen, and implication of aspen management for other land uses. The productivity of aspen is related to soil moisture conditions and texture. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Aspen, juvenile stand-tending, ecology, vegetation control—chemical, forest-damage agents, soil and site conditions

Steneker, G.A.; Jarvis, J.M. 1963. A preliminary study to assess competition in a white

spruce-trembling aspen stand. *For. Chron.* 39:334–336.

The authors evaluated the relationship between the size and distance to surrounding trees to explain diameter increment variation. The percentage of explained variance increased as the diameter of the sampling circle increased (56% with 7 m radius). Basal diameter measurements gave the best correlations. (Location: 63 D)

Key words: Competition analysis, aspen, white spruce

Steneker, G.A.; Jarvis, J.M. 1966. Thinning trembling aspen stands, Manitoba and Saskatchewan. *Can. Dep. For., Rural Dev., For. Branch, Ottawa, Ontario. Publ. 1140.*

This report combines and compares eight aspen-thinning experiments conducted between 1926 and 1951 in Manitoba and Saskatchewan. There was no consistency among methods for the experiments or return period for remeasurement; however, the purpose was to determine stocking levels necessary for maximizing volume production and diameter growth of aspen. Despite problems with methods among experiments, the paper offers some conclusions and recommendations for thinning practices. (Location: 62 F, K, N; 63 D)

Key words: Aspen, juvenile stand-tending, growth and yield

Steneker, G.A.; Prasad, R.A. 1972. Suckering and soluble sugars in trembling aspen root cuttings. *Environ. Can., Can. For. Serv., Ottawa, Ontario. Bi-mon. Notes* 28:34.

This study determines whether variation in aspen suckering is related to the amount of soluble sugars present in the parent roots. An analysis of variance indicates strong differences in sugar content of the clones between collection dates. There is a weak correlation between sugar and sucker growth. (Location: 62 K)

Key words: Aspen, plant propagation

Steneker, G.A.; Wall, R.E. 1970. Aspen clones, their significance and recognition. *Can. Dep. Fish. For., Can. For. Serv., For. Res. Lab., Winnipeg, Manitoba. Liaison Serv. Note* MS-L-8.

This paper is an overview of aspen clones. It briefly describes the development of clones, their significance, and how to recognize them based on differences in bark, leaf shape, flushing time, and leaf fall. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Aspen, ecology, genetics and cellular structure

- Steneker, G.A.; Wall, R.E. 1972. Wound healing and fungal colonization in stems of young trembling aspen after thinning and pruning. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-37.

This study analyzes the initial healing process in pruning wounds and preliminary fungal colonization of trunk rot fungi in thinned and unthinned 15-year-old aspen. It appears that pruned wounds heal more rapidly among thinned aspen. In unthinned plots, wound dressing resulted in slower wound healing and more extensive fungal colonization. (Location: 63 C)

Key words: Aspen, forest-damage agents, juvenile stand-tending

- Steneker, G.A.; Walters, M.A. 1971. The effect of root length upon the suckering of trembling aspen. Can. Dep. Fish. For., Can. For. Serv., For. Res. Lab., Edmonton, Alberta. Inf. Rep. A-X-46.

This study evaluates aspen roots cut to different lengths for their ability to produce suckers. Results suggest that sucker production is independent of root length. The authors find that suckers tend to form at the proximal end of the root, i.e., nearest the source of hormones. (Location: Manitoba)

Key words: Aspen, ecology, plant propagation, reforestation

- Stewart, J.D. 1991. The interaction of nitrogen supply and water stress in preconditioning lodgepole pine seedlings. Ph.D. thesis, Univ. Alta., Edmonton, Alberta.

- Stewart, J.D.; Lieffers, V.J. 1993. Preconditioning effects of nitrogen relative addition rates and drought stress on container-grown lodgepole pine seedlings. Can. J. For. Res. 23:1663-1671.

Treatment of lodgepole pine seedlings with different nitrogen and moisture levels suggests that nursery-stressed seedlings might be better suited to field planting than seedlings grown under optimal conditions. Under low nitrogen regimes, seedlings produce larger root systems, resulting in a better ability to cope with moisture stress. Also see Stewart (1991). (Location: Not applicable; laboratory study)

Key words: Soil and site conditions, plant propagation, lodgepole pine

- Stewart, J.D.; Lieffers, V.J. 1994. Diurnal cycles of rhizosphere acidification by *Pinus contorta* seedlings. Plant Soil 162:299-302.

Monitoring of hydroponic nutrient solutions that grew lodgepole pine seedlings reveals a diurnal change in pH levels. These changes in acidity occurred 1-2 hours after illumination was terminated, but were reversed once illumination was re-initiated. (Location: Not applicable; laboratory study)

Key words: Soil and site conditions, lodgepole pine

- Stewart, R.R.; MacLennan, R.R.; Kinnear, J.D. 1977. The relationship of plant phenology to moose. Sask. Dep. Tourism Renewable Resour., Regina, Saskatchewan. Tech. Bull. 3.

Browse quality and its energy value are determined for shrubs used by moose in eastern Saskatchewan. Browse is also assessed on a seasonal basis to determine if its value changes. Data on crude fiber content and digestible nutrients are provided for various seasons. (Location: 63 D, E)

Key words: Wildlife-habitat assessment, ungulates

- Stonehouse, H.B.; Ellis, J.G. 1983. The soils of the Hudson Bay and Saskatchewan portion of the Swan Lake map area (63D and 63C), Saskatchewan. Univ. Sask., Ext. Div., Sask. Inst. Pedol., Saskatoon, Saskatchewan. Publ. S5.

A soils inventory was conducted in an area southeast of Prince Albert (17 761 km²) and a 1:126 720-scale map depicting soil associations is presented. Ratings are developed for forest and agricultural capability, and area estimates are provided for each soil association as well as

physical and chemical analysis data for selected associations. Forest cover types are stratified by height class. (Location: 63 C, D)

Key words: Soil survey, land evaluation, soil and site conditions

Stringer, P.W. 1976. A preliminary vegetation survey of the Alberta Oil Sands Environmental Research Program study area. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 4.

Eighty-four vegetation stands in the Alberta Oil Sands Environmental Research Program area were sampled and are classified into physiognomic types that ranged from wetlands to coniferous and deciduous forests. Plant successional trends in the area are discussed, and a key for identification of these types on aerial photography is provided. (Location: 74 D, E, L; 84 A, H)

Key words: Vegetation classification, ecology

Strong, W.L. 1978. Biophysical land classification and evaluation of capability: Lakeland. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Publ. 63.

A 1:100 000-scale ecological land classification was prepared for a 3400-km² area in the lower portion of the B.18a forest section (Rowe 1972). A brief description is given for each ecosection. Canada Land Inventory equivalent ratings are provided for agriculture, forestry, recreation, ungulates, and waterfowl capability, as are assessments of soil limitations for selected recreational activities. (Location: 73 L)

Key words: Ecological land classification, land evaluation

Strong, W.L. 1981. Ecological land classification and evaluation: Jean D'Or Prairie. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/11-5.

A 1:100 000-scale ecological land classification is provided for the Fort Vermilion-Jean D'Or area (1455 km²). Five plant communities are recognized, two of which are dominated by aspen and/or balsam poplar. The characteristics of each ecosection are summarized in a legend. Agricultural capability for arable crops and grazing; tree-growth potential for white

spruce; ungulate habitat; and potential environmental hazards are rated. (Location: 84 J)

Key words: Ecological land classification, land evaluation

Strong, W.L. 1982. Ecological land classification and evaluation: Frost Hills area. Alta. Energy Nat. Resour., Edmonton, Alberta. Tech. Rep. T/11-6.

An ecological land classification at the ecosection level (1:50 000 scale) was prepared for a 1093-km² area along the southern side of Lesser Slave Lake. The study includes assessments of climate, soils, and vegetation. The common upland forest communities were dominated by a mixture of aspen and balsam poplar. Capability ratings are developed for agriculture, forestry, and wildlife habitat; and potential environmental hazards. (Location: 83 O)

Key words: Ecological land classification, land evaluation, wildlife-habit assessment

Strong, W.L. 1984. Below-ground ecology of boreal forests in the Hondo-Lesser Slave Lake area, Alberta. Ph.D. thesis, Univ. Alta., Edmonton, Alberta.

This research focuses on the belowground ecology of 11 boreal forest stands that include jack pine, white spruce, aspen, and mixedwood communities. Root densities of individual stands, the morphology of trees on different site conditions, plant-water relationships, and root density-nutrient relationships are reported. See Strong and La Roi 1983a, b, 1985, 1986. (Location: 83 O)

Key words: Ecology, vegetation assessment, soil and site conditions, tree-crop production, aspen, jack pine, white spruce, black spruce

Strong, W.L. 1988. Water management unit mapping and land use analysis of the Athabasca River basin in Alberta. Alta. Environ. Plann. Div., Edmonton, Alberta.

The Athabasca River drainage basin is subdivided into ecosections (1:1 500 000) and water management units, and each ecosection is rated for its agricultural suitability. The extent and location of cleared agricultural land

are also plotted. (Location: 83 F, J, N, O, P; 73 M; 74 D, E, L)

Key words: Ecological land classification, hydrology, land evaluation

Strong, W.L. 1990. Benchmark vegetation transects for monitoring grazing in the Peace River region. Alta. For. Lands Wildl., Public Lands Div., Peace River, Alberta.

Twelve permanent vegetation transects (50 m) were established in the Grande Prairie–Peace River region to monitor natural vegetation as part of a forest-grazing program. Plant cover and composition, and biomass data, were collected as part of the analysis. (Location: 83 M, N)

Key words: Vegetation assessment, forest grazing

Strong, W.L. 1992. Ecoregions and ecodistricts of Alberta. Alta. For. Lands Wildl., Land Inf. Serv. Div., Edmonton, Alberta. Publ. T/244.

This report is an updated version of the *Ecoregions of Alberta* classification by Strong and Leggat (1981). This update includes some ecoregion name changes, reorganization of the boreal forest classification, and a quantitative analysis of several climatic parameters. In addition, a provincial ecodistrict classification is developed at a scale of 1:1 000 000. (Location: Alberta)

Key words: Ecological land classification, climate and related effects, physical land classification and geology, ecology

Strong, W.L. 1996a. Ecosection classification of the Waskahigan and portions of the Simonette and Economy administrative areas, Canadian Forest Products Ltd. forest management area. Canadian Forest Products Ltd., Grande Prairie, Alberta.

A 1:100 000-scale ecological land classification is developed for a 1740-km² area, located primarily within the Lower Boreal–Cordilleran ecoregion. Most data for this classification are derived from existing sources, except the vegetation component, which is based on field observations. (Location: 83 K)

Key words: Ecological land classification

Strong, W.L. 1996b. Statistical analysis of 1992 to 1995 data from Shining Bank Lake experimental block 18 (Trial A). Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta.

This experimental study evaluates aspen suckering following brush cutting. Preliminary results suggest that 1-m-radius plots, cut at ground level during early summer, minimize the resprouting of aspen suckers. The data used in this study were compiled by the Canadian Forest Service and represent a preliminary analysis. (Location: 83 G)

Key words: Vegetation control—mechanical, juvenile stand-tending, aspen

Strong, W.L.; Kennedy, L.L. 1986a. O'Chiese Reserve—and resource assessment and development guidelines. O'Chiese Band, Rocky Mountain House, Alberta and Can. For. Serv., North. For. Cent., Edmonton, Alberta.

The O'Chiese Reserve (120 km²) is ecologically classified (1:21 120 scale) to the ecosite level and assessed for tree growth capability, agriculture, and environmental hazards for integrated resource planning purposes. (Location: 83 B)

Key words: Ecological land classification, vegetation assessment, land evaluation

Strong, W.L.; Kennedy, L.L. 1986b. Sunchild Cree Reserve—land resource assessment and development guidelines. Sunchild Band, Rocky Mountain House, Alberta and Can. For. Serv., North. For. Cent., Edmonton, Alberta.

The Sunchild Reserve (52 km²) is ecologically classified (1:21 120 scale) to the ecosite level and assessed for tree growth capability, agriculture, and environmental hazards for integrated resource planning purposes. The guidelines are part of the assessment of a classification of plant community-types. (Location: 83 B)

Key words: Ecological land classification, vegetation assessment, land evaluation

Strong, W.L.; La Roi, G.H. 1983a. Rooting depth and successional development of selected boreal forest communities. Can. J. For. Res. 13:577–588.

In this study, root densities and depths are compared to determine if rooting depth increases with stand age. Results are mixed, but rooting depth did increase on sandy soils. Most plant roots were located near the forest-floor surface. (Location: 83 O)

Key words: Ecology, soil and site conditions, aspen, white spruce, black spruce, jack pine

Strong, W.L.; La Roi, G.H. 1983b. Root-system morphology of common boreal forest trees. Can. J. For. Res. 13:1164-1173.

This paper describes the root-system morphology of common boreal trees, including aspen. On sandy sites, deeply penetrating roots of aspen were common, but on fine-textured soils, roots tended to be more horizontally oriented. (Location: 83 O)

Key words: Ecology, aspen, white spruce, black spruce, balsam fir, jack pine

Strong, W.L.; La Roi, G.H. 1985. Root density-soil relationships in selected boreal forest communities of central Alberta. For. Ecol. Manage. 12:233-251.

Root densities relative to depth, extractable nutrients, and abiotic factors are compared in aspen, mixedwood, jack pine, and black spruce stands. Results suggest a positive association with water-holding capacity and extractable phosphorus, and a negative relationship to depth, clay content, and soil bulk density. (Location: 83 O)

Key words: Ecology, soil and site conditions

Strong, W.L.; Leggat, K.R. 1981. Ecoregions of Alberta. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Tech. Rep. T/4.

In this study, Alberta is subdivided into 12 ecoregions on the basis of climate, vegetation, and other ecological information. This classification is primarily a synthesis and interpretation of information available at the time of writing. The vegetation and climatic characteristics of each ecoregion are described. (Location: Alberta)

Key words: Ecological land classification, climate and related effects, ecology

Strong, W.L.; Leggat, K.R. 1992. Ecoregions of Alberta. Alta. For. Lands Wildl., Land. Inf. Serv. Div., Edmonton, Alberta. Publ. T/245.

This work is an update of Strong and Leggat (1981) and a generalized version of Strong (1992) for public distribution. (Location: Alberta)

Key words: Ecological land classification, climate and related effects, ecology

Strong, W.L.; Navratil, S.; Sidhu, S.S.; Thompson, J.M. 1995. Vegetation management by chemical and mechanical methods in aspen (*Populus tremuloides*)-dominated clearcuts: analysis of coniferous crop seedlings and selected competition variables. Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Alta. Land For. Serv., Edmonton, Alberta. Can.-Alta. Partnership Agreement For. Rep. 128.

This paper correlates white spruce and lodgepole pine seedling growth parameters with vegetation composition and woody plant density parameters according to different site preparation and conifer release treatments. Seedling basal diameters followed by height are found to be most consistently correlated with vegetation characteristics. In total, 256 significant ($P < 0.05$) regression equations are also developed to predict selected seedling growth characteristics, but few of the variables are consistently useful. (Location: 83 L)

Key words: Competition analysis, site preparation, vegetation control—chemical, vegetation control—mechanical, ecology, aspen

Strong, W.L.; Oswald, E.T.; Downing, D.J., eds. 1990. The Canadian system of vegetation classification. Environ. Can., Can. Wildl. Serv., Ottawa, Ontario. Ecol. Land Classif. Ser. 25.

This work presents a national vegetation classification system for Canada. The upper levels of the classification are based on physiognomic characteristics, while the most detailed levels of classification (i.e., community-type) are based on stand structure, species composition, and abundance. (Location: Canada)

Key words: Vegetation classification

Strong, W.L.; Sidhu, S.S.; Navratil, S. 1995. Vegetation management by chemical and mechanical

methods in aspen (*Populus tremuloides*)-dominated clearcuts: vegetation response 6 years after treatment. Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Alta. Land For. Serv., Edmonton, Alberta. Can.-Alta. Partnership Agreement For. Rep. 122.

Changes in vegetation composition and structure are assessed with respect to hexazinone (2 and 4 kg/ha), Rome double-disking, and disk-trenching treatments following the clear-cutting of an aspen-dominated area. Data are from about 900 permanent plots sampled prior to treatment and 1 and 6 years after treatment. Also included are similar analyses of 600 plots from four treatments (disk-trenching followed by brush-cutting, disk-trenching followed by the application of 2 and 4 kg/ha hexazinone, Rome double-disking), which were established to evaluate conifer release methods. Rome double-disking tended to be the more successful technique for improving coniferous seedling growth, but it largely destroyed the native vegetation. (Location: 83 L)

Key words: Site preparation, vegetation control—mechanical, vegetation control—chemical, vegetation assessment, aspen, lodgepole pine, white spruce

Strong, W.L.; Thompson, J.M. 1995. Ecodistricts of Alberta: summary of biophysical attributes. Alta. Environ. Prot., Resour. Data Div., Edmonton, Alberta. Publ. T/319.

A geographical information system attribute data base is developed for 323 broadly defined ecodistrict polygons within Alberta (1:1 000 000). Ecodistricts were defined by Alberta Environmental Protection and were stratified according to natural regions. Included in the data base are landform, topography, soil great group, texture, drainage, vegetation physiognomy, and wetland and lake frequency attributes. (Location: Alberta)

— **Key words:** Ecological land classification, physical land classification and geology

Sunquist, K.M.; Alexander, M.J.; Olsen, R.; Willoughby, M.G.; Smith, D. 1997. Range plant community types and carrying capacity for the lower foothills subregion, second

approximation. Alta. Environ. Prot., Edmonton, Alberta. Publ. T/347.

A total of 100 range-oriented community-types in the Lower Boreal-Cordilleran ecoregions of northern Alberta are recognized. These include tame and native grasslands; shrublands; deciduous, mixedwood, and coniferous forests; and cutblock types. Individual community-types descriptions identify general management concerns, species composition and average canopy cover, typical site conditions, and a suggested stocking rate. (Location: Northern Alberta)

Key words: Forest grazing, vegetation classification

Swan, E.P.; Kellogg, R.M. 1986. Chemical properties of black cottonwood and balsam poplar. Can. J. For. Res. 16:497-501.

This study compares the lignin content of black poplar from British Columbia and balsam poplar from Alberta. The two species were similar, although the heartwood contained more lignin than did the sapwood. The balsam poplar samples were from Alberta. (Location: British Columbia, Alberta; 83 G, O, P)

Key words: Economics—fiber, balsam poplar, genetics and cellular structure

Swan, J.M.A. 1964. A phytosociological study of upland boreal forest at Candle Lake, Saskatchewan. M.A. thesis, Univ. Sask., Saskatoon, Saskatchewan.

Swan, J.M.A.; Dix, R.L. 1966. The phytosociological structure of upland forest at Candle Lake, Saskatchewan. J. Ecol. 54:13-40.

The structure and composition of upland forests in the Candle Lake region are analyzed. From the data, the authors suggest that a relationship exists between canopy structure and the subcanopy, and between canopy structure and soil texture and disturbance. *Also see* Swan (1964). (Location: 73 H)

Key words: Vegetation assessment, soil and site conditions, fire ecology

Swanson, R.H.; Hillman, G.R. 1977a. Effect of large-scale clear-cutting on water yield in western

Alberta. Pages 256–271 in R.H. Swanson and P.A. Logan, comp. *Alberta Watershed Research Program. Proc. Symp.*, August 31–September 1, 1977, Edmonton, Alberta. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-176.

A 27% increase in annual stream flow was measured on partially clear-cut lands relative to native conditions. Eighteen basins are used in this analysis, with half of them subjected to forest harvesting. The amount of area cut in individual basins ranged from 37 to 84%. (Location: 83 F)

Key words: Forest-harvesting effects, hydrology

Swanson, R.H.; Hillman, G.R. 1977b. Predicted increased water yield after clear-cutting verified in west-central Alberta. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-198.

This study verifies predicted water-yield increases of 20–30% following clear-cut harvesting. Results show a 27% increase in water yield and a 59% increase in stream flow at the time of snowmelt. (Location: 83 F)

Key words: Forest-harvesting effects, climate and related effects, hydrology

Swanson, R.H.; Stevenson, D.R. 1971. Managing snow accumulation and melt under leafless aspen to enhance watershed value. Pages 63–69 in *Proc., Western Snow Conf.*, April 20–22, 1971, Billings, Montana. Colo. State Univ., Fort Collins, Colorado.

This paper identifies the influence of leafless trees and shrubs on the distribution of snow, and how vegetation might be manipulated to achieve hydrological management goals. Leafless aspen and willow stands are important in localizing snow and altering the ablation rate. Small openings in a leafless canopy are effective snow traps. Openings of a size and design to maximize accumulation and minimize ablation improve groundwater-recharge opportunities if created on recharge areas. (Location: 82 G)

Key words: Hydrology, vegetation assessment

Syncrude Canada Ltd. 1973. The habitat of Syncrude Tar Sands Lease #17—an initial evaluation. Syncrude Canada Ltd., Edmonton, Alberta. Environ. Res. Monogr. 1973-1.

This report is an overview of biophysical resources on Lease 17 of the Syncrude oil sands area located north of Fort McMurray, including selected wildlife resources. A 1:50 000-scale vegetation map is included, with typing based on overstory dominants. Most of this report is based on quotes and observations. (Location: 74 D, E)

Key words: Vegetation assessment, wildlife-habitat assessment

Synergy West Ltd. 1977. Biophysical analysis and evaluation of capability: McLennan area. Alta. Energy Nat. Resour., Edmonton, Alberta.

A biophysical analysis and land classification (1:126 720) is presented to the ecosection level for the McLennan area. The classification is strongly oriented toward physical resources. Capability ratings are developed for agriculture, forestry, recreation, ungulates, and waterfowl. (Location: 83 O, N; 84 C)

Key words: Ecological land classification, land evaluation

Tanner, D.; Delong, S.C.; Eastman, A. 1996. Investigations of planting white spruce under a trembling aspen canopy. Pages 114–121 in P.G. Comeau and K.D. Thomas, eds. *Silviculture of temperate and boreal broadleaf-conifer mixtures. Proc. Symp.*, February 28–March 1, 1995, Richmond, British Columbia. B.C. Minist. For., Victoria, British Columbia. Land Manage. Handb. 36.

This study provides preliminary results on the growth of white spruce planted beneath mature aspen. The authors suggest that this practice will increase height-increment growth, reduce frost damage and understory competition for white spruce seedlings, and help maintain a tree cover after harvesting. (Location: 93 P)

Key words: Uneven-aged stand management, reforestation, tree-crop production, white spruce

Taylor, W.S.; Knapik, L.J.; Achuff, P.L. 1989a. Biophysical inventory and land use evaluation of

the Fawcett Lake shoreline area. Alta. For. Lands Wildl., Land Inf. Serv. Div., Edmonton, Alberta.

A 1:15 000-scale ecological land classification is developed for an 87-km² area around Fawcett Lake. Included in the classification are surficial materials, soil attributes, and vegetation physiognomy. The area is assessed for a variety of facility and recreation uses. (Location: 83 O, P)

Key words: Ecological land classification, soil and site conditions, land evaluation

Taylor, W.S.; Knapik, L.J.; Achuff, P.L. 1989b. Bio-physical inventory and land use evaluation of the Obed Lake shoreline area: ecological land classification. Alta. For. Lands Wildl., Land Inf. Serv. Div., Edmonton, Alberta.

A 1:15 000-scale ecological land classification is developed for a 26-km² area around Obed Lake. Included in the classification are surficial materials, soil attributes, and vegetation physiognomy. The area is assessed for a variety of facility and recreation uses. (Location: 83 F)

Key words: Ecological land classification, soil and site conditions, land evaluation

Telfer, E.S. 1974. Logging as a factor in wildlife ecology in the boreal forest. For. Chron. 50:186-190.

The potential effects of clear-cutting are reviewed with respect to wildlife habitat needs. The author concludes that primary problems with clear-cutting are reduced stand and species diversity. These problems could be minimized by leaving strips of mature vegetation, lengthening the intervals between removal of adjacent strips, and using partial cuts. (Location: Canada)

Key words: Forest-harvesting effects, vegetation assessment, wildlife-habitat assessment, ungulates, furbearers, small mammals, birds

Telfer, E.S. 1978. Cervid distribution, browse and snow cover in Alberta. J. Wildl. Manage. 42:352-361.

This study identifies factors that control winter distribution of ungulates by examining the

relationship among browse availability, snow depth, and Cervid distributions in three areas of Alberta. It appears from the information gathered that elk and deer winter use is not strongly related to browse availability, but is instead connected to traditional wintering areas and human disturbance. Moose distributions could be altered and populations increased by manipulating browse supply. (Location: 83 H)

Key words: Wildlife distribution and diversity, wildlife-habitat assessment, climate and related effects, ungulates

Telfer, E.S. 1984. Circumpolar distribution and habitat requirements of moose (*Alces alces*). Pages 145-182 in R. Olson, R. Hastings, and F. Geddes, eds. Northern ecology and resource management. Univ. Alta. Press, Edmonton, Alberta.

The author provides an overview of the distribution and habitat requirements for moose in northern latitudes. Factors limiting the distribution and habitat use by season are discussed. Wet upland sites such as deltas, floodplains, and valleys are considered stable habitats for moose. (Location: Canada)

Key words: Wildlife distribution and diversity, wildlife-habitat assessment, ungulates

Telfer, E.S.; Cairns, A. 1978. Stem breakage by moose. J. Wildl. Manage. 42:639-642.

This paper estimates the amount of extra winter food that moose could obtain by breaking stems taller than their usual limit of 2.4 m, and assesses the impact of stem breakage on the vegetation structure. The authors suggest that breakage of aspen saplings, combined with heavy browsing on low shrubs and saplings, has slowed vegetation succession in Elk Island National Park. (Location: 83 H)

Key words: Wildlife-habitat assessment, vegetation assessment, ungulates

Telfer, E.S.; Scotter, G.W. 1969. Potential for game ranching in boreal aspen forests of western Canada. J. Range Manage. 28:172-180.

This paper discusses the potential of using mixedwood forests for game-ranching. Among the variables considered are snow cover, soil productivity, understory vegetation, disease

and parasites, and competition with native populations. The authors suggest that social concerns are also a major consideration. (Location: 83 H)

Key words: Forest grazing, vegetation assessment, wildlife-habitat assessment, ungulates

Thomas, G.P.; Etheridge, D.E.; Paul, G. 1960. Fungi and decay in aspen and balsam poplar in the Boreal Forest Region, Alberta. Can. J. Bot. 38:459-466.

The results of this aspen and balsam poplar decay survey show that 73% of the aspen and 61% of the balsam poplar were decayed. For aspen, infection decreased from mesic to dry sites; however, for balsam poplar there was little difference in infection, according to moisture conditions. The loss of volume due to decay for aspen and balsam poplar was 25 and 100%, respectively. Frequency and effects of various fungi are described. (Location: 83 J, K, L, N, O)

Key words: Forest-disease agents, economics—fiber, aspen, balsam poplar

Thomas, P.A.; Wein, R.W. 1990. Jack pine establishment on ash from wood and organic soil. Can. J. For. Res. 20:1926-1932.

For this study, different types of ashed duff and coarse woody debris were tested to determine if ash from various sources affects jack pine seed germination and seedling survival rates. Results suggest that ashed duff did not have a negative effect, and leaching could improve seedling survival. In contrast, seed germination was poor on ashed wood. (Location: Northwest Territories)

Key words: Fire ecology, jack pine, soil and site conditions, fire management and effects, site preparation

Thompson, D.C.; Ealey, D.M.; McCourt, K.H. 1980. A review and assessment of the baseline data relevant to the impacts of oil sands developments on large mammals in the AOSERP study area. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 64.

This is a comprehensive literature review that presents available data on the impact of

oil-sands development on moose, woodland caribou, and wolf population parameters. Major gaps are identified in the baseline knowledge for these large mammals. (Location: 74 D, E)

Key words: Environmental impacts, ungulates, furbearers

Thompson, M.D.; Wride, M.C.; Kirby, M.E. 1978. Ecological habitat mapping of the AOSERP study area. Phase I. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 31.

This study presents preliminary wildlife-habitat maps at a scale of 1:50 000 for the Alberta Oil Sands Research Program area from false-color infrared photographs. Among the parameters included are assessments of vegetation, terrain, soils, and hydrology. (Location: 74 D, E; 84 A, H)

Key words: Remote sensing, ecological land classification, ungulates, birds, wildlife-habitat assessment

Thorpe, J.P. 1978. Effects of cattle grazing on understory shrubs in Saskatchewan aspen forests. M.Sc. thesis, Univ. Sask., Saskatoon, Saskatchewan.

This study finds that cattle and wild ungulates browse similar species. With grazing, *Viburnum edule* and *Amelanchier alnifolia* decreased, while *Rubus idaeus*, *Corylus cornuta*, *Rosa acicularis*, *Symphoricarpos albus*, and *Lonicera involucrata* increased. Grazing tended to reduce browse production, and the more intensive the browsing, the less productive the plants. (Location: 73 F)

Key words: Forest grazing, ungulates, vegetation assessment

Thorpe, J. 1991. An assessment of Saskatchewan's system of forest site classification. Sask. Res. Council, Saskatoon, Saskatchewan. Publ. E-2530-1-E-90.

This paper reviews the forest-site classification system used in Saskatchewan. This system relies on the use of soil-drainage classes and texture for site assessment. The author advocates the use of a more ecologically oriented and comprehensive hierarchical approach

based on vegetation, soils, and site conditions.
(Location: Saskatchewan)

Key words: Ecological land classification

- Tidsbury, C.; Emond, F.J.; Cerezke, F.J. 1992. Spruce spider mite. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 14.**

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of spruce spider mite. (Location: Canada)

Key words: Forest-damage agents, white spruce, pest control

- Tietje, W.D.; Ruff, R.L. 1980. Denning behaviour of black bears in boreal forest of Alberta. J. Wildl. Manage. 44:858-870.**

Denning chronology and behavior of black bears are investigated in east-central Alberta. Bears selected mixed stands of aspen and white spruce or mature spruce for denning sites. Denning normally occurred between mid-October and early April. (Location: 73 L)

Key words: Wildlife distribution and diversity, wildlife-habitat assessment, furbearers

- Timmermann, H.R.; McNicol, J.G. 1988. Moose habitat needs. For. Chron. 64:238-245.**

This paper, a comprehensive review of moose-habitat needs in North America, indicates that optimum habitats for moose contain an interspersed of food and cover within traditionally used seasonal home ranges. Aspen was important both as browse and shelter. (Location: North America)

Key words: Ungulates, wildlife-habitat assessment, aspen

- Tomm, H.O. 1978. Response of wild ungulates to logging practices in Alberta. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.**

An assessment of the effects of logging practices on wild ungulates (moose, deer, and elk) was conducted in the forests of west-central Alberta. Analysis of variance indicates that distance from cover was a significant factor affecting the use of clear-cut blocks by ungulates. There is a significant difference by species in

distance. Moose use was more uniform over cutblocks, compared to deer or elk use. Deer and elk showed a preference for cutblock edges. (Location: 83 B, C, F, G, J, K, L, M)

Key words: Ungulates, forest-harvesting effects

- Tomm, H.O.; Beck, J.A. Jr.; Hudson, R.J. 1981. Responses of wild ungulates to logging practices in Alberta. Can. J. For. Res. 11:606-614.**

The use of cutblocks by moose, mule deer, and elk are compared to postlogging treatment. The study finds that these species are affected by design and treatment. Recommendations are made to maximize ungulate use. (Location: 83 B, F, G, J, K, L, M)

Key words: Ungulates, forest-harvesting effects

- Trottier, G.C. 1980. Beaked hazelnut—a key browse species for moose in the boreal forest region of western Canada. Alces 17:257-281.**

This paper summarizes the distribution, ecology, and importance of hazelnut as browse to moose. Relative to other common browse species, hazelnut tends to be more resistant to high-intensity browsing. Nutrient analyses are presented for beaked hazelnut, willows, aspen, saskatoon, and dogwood. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Ungulates, wildlife-habitat assessment, vegetation assessment

- Tucker, R.E.; Jarvis, J.M. 1967. Prescribed burning in a white spruce-aspen stand in Manitoba. Pulp Pap. Mag. Can. 68:333-355.**

The use of prescribed burning as a silvicultural tool in spruce-aspen stands is investigated. Burning resulted in the removal of the aboveground vegetation cover, but due to the high moisture content of the FH horizon, the roots were largely unaffected. (Location: 62 K)

Key words: Fire management and effects, soil and site conditions, fire ecology, white spruce, aspen

- Turchenek, L.W.; Lindsay, J.D. 1982. Soils inventory of the Alberta Oil Sands Environmental Research Program study area. Alta. Environ., Alta. Oil Sands Environ. Res. Program, Edmonton, Alberta. AOSERP Rep. 122.**

A soil survey (1:126 720) was conducted in the AOSERP area (28 440 km²). This report provides soils maps and information on the type, characteristics, and aerial distribution of soils in the study area. Capability classifications are provided for forestry, agriculture, engineering, wildlife, recreational use, and soil sensitivity to acid deposition. Volume 2 contains profile descriptions and chemical and physical attributes. (Location: 74 D, E, L)

Key words: Soil survey, land evaluation, soil and site conditions

Twardy, A.G. 1978. Soil survey of a portion of the Syncrude Lease 17 area, Alberta. Syncrude Canada Ltd., Edmonton, Alberta.

A 1:24 000-scale soils map is presented for Lease 17 of the Syncrude oil sands area (93 km²), located north of Fort McMurray. Physical and chemical characteristics are provided for individual types of soil, while selected characteristics are provided for sampled sites. (Location: 74 E)

Key words: Soil survey, soil and site conditions

Twardy, A.G.; Corns, I.G.W. 1980. Soil survey and interpretations of the Wapiti map area. Alta. Res. Council and Alta. Inst. Pedol., Edmonton, Alberta. Rep. 39.

In this paper, soils are inventoried and mapped at a scale of 1:126 720 within a 14 000-km² area south of Grande Prairie, Alberta. The northeast half of the study area occurs within the B.18a and B.19a forest section (Rowe 1972). Each soil association is described, while chemical and physical data are provided for selected series. Soil series are also evaluated for their agricultural capability and selected forest management activities. *Also see* Corns (1978, 1983). (Location: 83 L)

Key words: Soil survey, soil and site conditions, land evaluation

Twardy, A.G.; Lindsay, J.D. 1971. Reconnaissance soil survey of the Chip Lake area. Res. Council. Alta., Edmonton, Alberta. Rep. 91.

A soils inventory and classification (1:126 720 scale) to the series level is provided for in the Chip Lake area (5560 km²) west of Edmonton. Profile descriptions are given for

each series and, for selected profiles, physical and chemical properties are summarized. Twelve series are interpreted for forest-management limitations with respect to soil characteristics. (Location: 83 G)

Key words: Soil survey, soil and site conditions

Urban, S.T.; Lieffers, V.J.; Macdonald, S.E. 1994. Release in radial growth in the trunk and structural roots of white spruce as measured by dendrochronology. Can. J. For. Res. 24:1550-1556.

This study evaluates the effects of release on white spruce stem and root-diameter growth in mixedwood stands ($n = 10$ trees). Growth release was in response to road right-of-way clearance. The authors conclude that release results in increased radial-root growth relative to stem growth, which is a mechanism for increasing wind-firmness of trees. (Location: 83 J)

Key words: Forest-harvesting effects, reforestation, uneven-aged stand management

Usher, R.G. 1978. The response of moose and woody browse to clearing in the boreal mixedwood zone of Alberta. M.Sc. thesis, Univ. Calgary, Calgary, Alberta.

The effects of forest clearing on browse production and moose use are investigated in this paper. It was found that shrubs/tree saplings and grass species increased in abundance relative to comparable mature stands. Variation in browse production is thought to be controlled by soil moisture availability. *Cornus stolonifera*, *Prunus pensylvanica*, *Prunus virginiana*, and *Betula* spp. were the preferred species on the cleared areas; *Salix*, *Populus tremuloides*, and *Viburnum edule* were most commonly used in the mature stands. (Location: 73 L)

Key words: Wildlife-habitat assessment, forest-harvesting effects, vegetation assessment, ungulates

Usher, R.G. 1981. Ungulate use and habitat capability of recently clear-cut forest blocks in the Sand River area of Alberta, and of different-aged stands in the Cold Lake region. Esso Resources Canada Ltd., Calgary, Alberta.

Not available for review. (Location: 73 L)

Key words: Wildlife-habitat assessment, forest-harvesting effects, vegetation assessment, ungulates

- Vaartaja, O. 1960.** Ecotypic variation of photoperiodic response in trees especially in two *Populus* species. *For. Sci.* 6:200-206.

This study investigates the effect of photoperiodic differences between northern and southern aspen seedlings. Results suggest that short days inhibit the growth of aspen in Saskatchewan, compared to more southerly latitudes. In addition, the proportion of root was much greater in northern locations than in southern locations. (Location: 73 H; United States)

Key words: Climate and related effects, aspen

- Van Camp, J.; Telfer, E.S. 1975a.** Browse yield and use by ungulates in Elk Island National Park, 1973-74. *Environ. Can., Can. Wildl. Serv., Ottawa, Ontario. Prog. Rep.*

This study assesses browse use in Elk Island National Park based on permanent transects established in 1972. Browse use between 1971-72 and 1973-74 are compared. In general, use is considered to be quite high, with aspen and balsam poplar representing 57% of total browse. (Location: 83 H)

Key words: Ungulates, vegetation assessment, wildlife-habitat assessment

- Van Camp, J.; Telfer, E.S. 1975b.** Hare habitat and cover relationships in Elk Island National Park. *Can. Wildl. Serv., Edmonton, Alberta.*

The habitats used by snowshoe hare are examined based on pellet counts, runways, and other signs. Hare were primarily found in mixedwood stands, while coniferous swamps and deciduous forests were not used as intensively. Sites preferred by hare were dominated by dense shrubs. Deciduous stands provided the greatest browse potential, while coniferous and mixedwood stands provided more cover. Ungulate browsing is considered a significant factor in limiting habitat quality for hares (e.g., reducing visual cover and thermal cover in winter). (Location: 83 H)

Key words: Wildlife-habitat assessment, furbearers, small mammals

- Van Groenewoud, H. 1961.** Variation in pH buffering capacity of the organic layer of grey wooded soils. *Soil Sci.* 92:100-105.

Methodological concerns with the measurement of pH in forest soils are evaluated. The author finds that buffering can be an important factor, and that pH values are often not normally distributed. The author suggests using large samples for testing. (Location: Saskatchewan)

Key words: Soil and site conditions

- Van Kooten, G.C.; Arthur, L.M. 1988.** Assessing economic benefits of climate change on Canada's boreal forest. *Can. J. For. Res.* 19:463-470.

This paper describes a simple approach to examining the benefits of climate change given that the productivity of Canada's boreal forests is expected to increase due to global warming. The author suggests that it might be premature to predict the net benefits of climate change with respect to forest products. Even if forest productivity is increased, this change may not be beneficial to Canada's overall welfare. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Climate and related effects, economics—fiber

- Van Waas, C. 1977a.** Biophysical analysis and evaluation of capability: Dixonville. *Alta. Energy Nat. Resour., Land Use Assign. Comm., Edmonton, Alberta.*

A natural-resources inventory, biophysical land classification (1:126 720), and capability assessment (agriculture, forestry, recreation, ungulates, and waterfowl) are provided for the Dixonville area (3300 km²). This classification is strongly oriented toward physical resources, and has limited information on vegetation. (Location: 84 C)

Key words: Ecological land classification, land evaluation

- Van Waas, C. 1977b.** Biophysical analysis and evaluation of capability: Whitemud Hills. *Alta. Energy Nat. Resour., Land Use Assign. Comm., Edmonton, Alberta.*

A natural-resources inventory, biophysical land classification (1:126 720), and capability assessment (agriculture, forestry, recreation, ungulates, and waterfowl) are provided for the Whitemud Hills, located northwest of Peace River. This classification is strongly oriented toward physical resources, and has limited information on vegetation. (Location: 84 C, D)

Key words: Ecological land classification, land evaluation

- Van Waas, C. 1978. Biophysical analysis and evaluation of capability: Whitecourt area. Alta. Energy Nat. Resour., Resour. Eval. Plann. Div., Edmonton, Alberta. Rep. 61.**

A biophysical land classification (1:126 720 scale) is provided for 2700 km² in the vicinity of Whitecourt, Alberta. The primary criteria used in the classification are topography and soils. The area includes both the B.18a and B.19a forest sections (Rowe 1972). Canada Land Inventory equivalent ratings are given for agriculture, forestry, ungulates, and waterfowl. (Location: 83 F, G, J, K)

Key words: Ecological land classification, land evaluation

- Van Waas, C.; Boyacioglu, E. 1973. Biophysical analysis and evaluation of capability: Lake George. Alta. Lands For., Edmonton, Alberta.**

This report presents a biophysical analysis (1:63 360) of the Lake George area. Each ecosystem is described in terms of physiography, soil associations, present use, natural cover, and agro-climate zone. Suitability ratings are given for agriculture, forestry, ungulates, recreation, and waterfowl. (Location: 84 D)

Key words: Ecological land classification, land evaluation

- Vega Garcia, C. 1994. Predicting human-caused forest fire occurrence in Whitecourt forest, Alberta. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.**

A binary (yes/no) model was developed to predict human-caused fires. This model has a reliability rate of 76%. The variables included in this predictive model are relative humidity, fire weather index, fire fuels moisture code, and road occurrence within 5 km. (Location: 83 J)

Key words: Fire management and effects, recreation

- Volney, W.J.A. 1988a. Analysis of historic jack pine budworm outbreaks in the prairie provinces of Canada. Can. J. For. Res. 18:1152-1158.**

Forest insect and disease survey records from 1937 to 1986 are reviewed to determine if a relationship exists between jack pine budworm outbreaks and fire history. Outbreaks are found to be associated with the amount of land burned several years earlier. The study also finds that the size of an outbreak is related to size of the previous year's outbreak, and a trend of increasingly larger outbreak events with time is identified. (Location: Saskatchewan, Manitoba)

Key words: Pest control, jack pine, forest-damage agents

- Volney, W.J.A. 1988b. Insects and diseases of the mixedwood forest: problems and opportunities? Pages 99-109 in J.K. Samoil, ed. Management and utilization of northern mixedwoods. Proc. Symp., April 11-14, 1988, Edmonton, Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-296.**

This paper describes the benefits and impacts of the forest tent caterpillar on the annual stemwood and foliage production of aspen. One potential benefit of tent caterpillar defoliation, the author concludes, is the stimulation of understory tree growth. (Location: Canada)

Key words: Forest-damage agents, aspen, growth and yield

- Volney, W.J.A. 1989. The aspen leaf beetle. Can. For. Serv., North. For. Cent., Edmonton, Alberta. For. Insect Disease Notes A-013.**

This note on forest insect and disease provides the following information on the aspen leaf beetle: description, feeding patterns, life cycle, reproductive biology, and population dynamics. At the time of publication, no controls had been developed for this defoliator. (Location: Canada)

Key words: Forest-damage agents

Volney, W.J.A. 1994. Jack pine budworm. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 32.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of jack pine budworms. (Location: Canada)

Key words: Forest-damage agents, jack pine, pest control

Volney, W.J.A. 1995. Bruce spanworm. Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 34.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of bruce spanworm. (Location: Canada)

Key words: Forest-damage agents, aspen, balsam poplar, pest control

Volney, W.J.A. 1996. Climate change and management of insect defoliators in boreal forest ecosystems. Pages 79–87 in M.J. Apps and D.T. Price, eds. Forest ecosystems, forest management and the global carbon cycle. Springer-Verlag, Berlin, Germany. NATO ASI Ser. Vol. 140.

The author suggests that increasing climatic extremes associated with global warming could be responsible for increasing outbreaks of forest defoliators. The paper discusses the relationship between spruce and pine budworm growth cycles and climatic conditions. (Location: Canada)

Key words: Climate and related effects, pollution effects, forest-damage agents

Volney, W.J.A.; Cerezke, H.F. 1992. The phenology of white spruce and the spruce budworm in northern Alberta. Can. J. For. Res. 22:198–205.

This paper concludes that spruce budworm emergence and feeding occur primarily during the period of bud emergence, but prior to shoot lignification. This generally corresponds to an accumulation of 75–750 degree-days with threshold temperatures of at least 6EC. (Location: 84 F)

Key words: White spruce, forest-damage agents, climate and related effects, ecology

Waddington, J.; Bittman, S. 1987. Control of brush regrowth in northeastern Saskatchewan by several concentrations of herbicides applied with a roller. Can. J. Plant Sci. 67:467–475.

The efficacy of a roller application of herbicides for brush control in pastures was tested at three sites in Saskatchewan. This method appears to be successful when the regrowth is 1- to 2-m tall, the brush regrowth is controlled for at least 2 years when individual plants receive adequate treatment. (Location: 72 J)

Key words: Vegetation control—chemical, forest grazing

Waldron, R.M. 1964. Converting aspen stands to white spruce by planting and seeding on scalped strips, Manitoba. Can. Dep. For., For. Res. Branch, Winnipeg, Manitoba. 64-MS-16.

This paper describes the methods used to convert mixedwood stands to spruce at several Manitoba sites. The primary method involves the planting of rows of white spruce on cleared strips in aspen-dominated stands. (Location: Manitoba)

Key words: Site preparation, aspen, white spruce

Waldron, R.M.; Kolabinski, V.S. 1994. Uniform shelterwood cutting and scarifying in white spruce-trembling aspen stands to induce natural white spruce regeneration, Manitoba and Saskatchewan. Nat. Resour. Can., Can. For. Serv., Manit. Dist. Office, Winnipeg, Manitoba, and Manit. Nat. Resour., Winnipeg, Manitoba. Can.-Manit. Partnership Agreement For. Rep.

Two-stage shelterwood harvesting with blade scarification is evaluated to determine its suitability for inducing white spruce regeneration in mixedwood stands. It was found that adequate stocking resulted and was better than unscarified seedbeds. Scarification resulted in greater seedling densities but were shorter than those on the unscarified site. The effectiveness of the tested system is similar to scarified clear-cut strips. Several recommendations are provided to facilitate successful stocking in a

two-stage shelterwood harvesting system. (Location: 62 K, N; 73 H)

Key words: Site preparation, uneven-aged stand management, white spruce, aspen

- Wall, R.E. 1969. Distribution of *Fomes ignarius* in aspen stands as affected by clonal variation. Can. Dep. Fish. For., Can. For. Serv., Ottawa, Ontario. Bi-mon. Res. Notes 25(1):5.

The objective of this study is to relate trunk rot incidence to clones in even-aged aspen stands. The results suggest that decay resistant clones could exist in any aspen stand. The cloning system of reproduction is thought to have a greater influence on the occurrence of trunk-rot than site conditions. (Location: Manitoba)

Key words: Forest-damage agents, aspen

- Wall, R.E. 1971. Variation in decay in aspen stands as affected by their clonal growth pattern. Can. J. For. Res. 1:141-146.

This study investigates the interclonal variation in decay within even-aged aspen stands, while taking into account the effects of site. The results demonstrate that there were highly significant differences among clones in percentage decay, volume of decay, and gross volumes. It is apparent that each clone had unique stem-rot patterns. (Location: Manitoba)

Key words: Aspen, forest-damage agents, genetics and cellular structure

- Wall, R.E.; Kalra, Y.P.; Prasad, R. 1971. Concentration of micronutrients in foliage of aspen (*Populus tremuloides* Michx.) in Manitoba. Can. Dep. Fish. For., Can. For. Serv., North. For. Res. Lab., Edmonton, Alberta. Inf. Rep. A-X-47.

This is a preliminary investigation to obtain information on micronutrient levels of aspen foliage in Manitoba. Levels of iron manganese, copper, and zinc are tabulated. Differences in micronutrient levels in groups of trees at the same location were not statistically different, except for manganese at the Bowsman location, where chlorotic trees were present. (Location: 63 C)

Key words: Aspen, vegetation assessment, soil and site conditions

- Wallis, C. 1987. The rare vascular flora of Alberta. Vol. 2. A summary of the taxa occurring in the Canadian shield, boreal forest, aspen parkland, and grassland natural regions. Alta. For. Lands Wildl., Edmonton, Alberta. Publ. T/164.

This report provides a listing of the rare vascular plants found in the boreal forest and other ecological zones. Species are listed according to geographical range and abundance. (Location: Alberta)

Key words: Unique resources

- Weatherill, R.G.; Keith, L.B. 1969. The effect of livestock grazing on an aspen forest community. Alta. Dep. Lands For., Fish Wildl. Div., Edmonton, Alberta. Tech. Bull. 1.

This study evaluates the effect of grazing by domestic livestock on an aspen forest community and on some common wildlife populations. Trees were not strongly affected by grazing. Taller herbs tended to be replaced by shorter and often more exotic species. Grazing was found to be beneficial for ruffed grouse, but populations of snowshoe hare, white-footed mouse, red-backed vole, and white-throated sparrows were apparently negatively affected by grazing. Grazing did not seem to affect shrews, oven birds, least flycatchers, and red-eye vireos. (Location: 83 J)

Key words: Forest grazing, wildlife-habitat assessment, birds, furbearers, small mammals

- Weaver, R.L. 1996. The effects of timber harvesting in the boreal forest on deer mice and red-backed voles. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

In this study, deer mice were found to be twice as abundant in clear-cuts as in forested stands, while red-backed voles were equally or slightly more common 1 year after timber harvesting. The abundance of deer mice tended to be positively associated with the distance from the forest edge, while a similar association was not found for red-backed voles. (Location: 73 M)

Key words: Forest-harvesting effects, small mammals, wildlife distribution and diversity

- Weetman, G.F. 1983. Fibre production from boreal forest ecosystems. Pages 28-34 in R.W. Wein,

R.R. Riewe, and I.R. Methven, eds. *Resources and dynamics of the boreal zone*. Proc. Conf., August 1982, Thunder Bay, Ontario. Assoc. Can. Univ. North. Studies, Ottawa, Ontario.

A general overview is given of boreal forest productivity, with comparisons to other geographical zones. General information is also provided about tree-growth rates for individual species. The author attributes the decline in tree availability to a lack of adequate reforestation. (Location: Canada)

Key words: Economics—fiber, growth and yield, black spruce, jack pine, aspen, white birch, balsam fir

Wehrhahn, R.L. 1981. Forage inventory of Brazeau-Pembina study area. Alta. Energy Nat. Resour., Edmonton, Alberta. Rep. T/19-2.

A forage inventory (1:50 000) was conducted in the Brazeau-Pembina area (3350 km²) in 1980. Species composition and biomass are provided for 28 forage types. An appendix contains the raw relevé data collected during the study. (Location: 83 B, C, F, G)

Key words: Vegetation assessment, vegetation classification, forest grazing

Wehrhahn, R.L. 1982. Forage inventory of the Chungo-Cline-Nordeg study area. Alta. Energy Nat. Resour., Edmonton, Alberta. Rep. T/19-4.

This paper reports on a forage inventory (1:50 000) of the Chungo-Cline-Nordeg study area (3900 km²) completed in 1981. Species composition and biomass were collected for 22 of the 24 forage types recognized in the area. An appendix contains the raw relevé data collected during the study. (Location: 83 C)

Key words: Vegetation assessment, forest grazing, vegetation classification

Wein, R.W.; El-Bayoumi, M. 1983. Limitations to predictability of plant succession in northern ecosystems. Pages 214–225 in R.W. Wein, R.R. Riewe, and I.R. Methven, eds. *Resources and dynamics of the boreal zone*. Proc. Conf., August 1982, Thunder Bay, Ontario. Assoc. Can. Univ. North. Studies, Ottawa, Ontario.

This paper identifies various factors that can affect the predictability of plant successional patterns. These factors include random occurrences, cyclic fluctuations, and spatial variability. This paper is in part a critique of computer-simulation systems for modeling plant-community successional development. (Location: Not applicable; literature review)

Key words: Ecology

Wein, R.W.; MacLean, D.A. 1983. The role of fire in northern circumpolar ecosystems. Scope 18. John Wiley and Sons, Chichester, England.

This book is an overview of fire and its ecological effects in boreal and other environments. Among the topics covered are nutrient cycling; fire frequency and suppression; effects on plants, small mammals and birds; and management of fire in park areas. (Location: Canada)

Key words: Fire ecology, small mammals, birds, fire management and effects

Weldwood of Canada Limited. 1990. Integrated management of timber and wildlife resources on the Weldwood Hinton Forest Management Area. Weldwood Can., Hinton, Alberta.

This report contains information on wildlife-habitat relationships. The habitat types are broadly defined according to plant community physiognomy. The implications of various forest-cutting methods are discussed in terms of their impact on wildlife. (Location: 83 F)

Key words: Wildlife-habitat assessment, forest-harvesting effects, ungulates, birds

Westworth, D.A.; Brusnky, L.M.; Burns, G.R. 1984. Impact on wildlife of short-rotation management of boreal aspen stands. Can. For. Serv., Edmonton, Alberta. ENFOR Proj. P-203.

This paper reviews the potential impact of aspen clear-cutting on wildlife. The study finds major differences in wildlife use according to forest vegetation age. Many of the changes in wildlife use are related to developmental changes in stand structure. Clear-cutting would increase breeding bird densities, but decrease suitable habitat for winter residents. Ungulate use of younger stands would increase relative to older growth. The authors stress the

importance of maintaining adequate food and cover throughout an area, including the need for mature and overmature forest stands. (Location: 83 B)

Key words: Forest-harvesting effects, birds, ungulates, wildlife-habitat assessment

Wheaton, E.E.; Singh, T.; Dempster, R.; Higginbotham, K.O.; Thorpe, J.P.; Van Kooten, G.C.; Taylor, J.S. 1987. An exploration and assessment of the implications of climatic change for the boreal forest and forestry economics of the prairie provinces and Northwest Territories: phase one. Sask. Res. Council, Saskatoon, Saskatchewan. Publ. E-906-36-B-87.

The implications of carbon dioxide-induced climatic change in the boreal forest of western Canada are assessed. The authors conclude that increased carbon dioxide could increase tree growth rates, but the forest-grassland interface might shift northward as a result of warmer temperatures. Such a shift could affect various forestry operations. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Climate and related effects

Wheeler, G.W.; Willoughby, M.G. 1993. Campbell Creek aspen regeneration grazing trial. Alta. For. Lands Wildl., Alta. For. Serv., Edmonton, Alberta.

The authors find that cattle grazing in aspen cutovers does not significantly effect the height or volume of regenerating aspen stands. Grazing prior to planting of white spruce, however, resulted in a 50% mortality during the first year of growth, but had little effect in the following years. White spruce seedling volume was greater on grazed sites, but height was greater on ungrazed sites. (Location: 83 L)

Key words: Forest grazing, reforestation, aspen

White, J. 1981. The allometric interpretation of the self-thinning rule. J. Theor. Biol. 89:475-500.

This paper reviews the self-thinning rule, and an attempt is made to refine the formula. (Location: Not applicable; laboratory study)

Key words: Growth and yield, juvenile stand-tending, competition analysis

Wiken, E., compiler. 1986. Terrestrial ecozones of Canada. Environ. Can., Lands Dir., Ottawa, Ontario. Ecol. Land Classif. Ser. 19.

This study subdivides Canada into 15 regional zones or ecozones based on common abiotic and biotic factors. A descriptive summary, which includes topography, climate, soil, and wildlife attributes, is provided for each ecozone, as is a tabular summary. The boreal mixedwood occurs primarily within ecozone 15, Boreal Plains. (Location: Canada)

Key words: Ecological land classification

Williams, G.D.V. 1985. Estimated bioresource sensitivity to climatic change in Alberta, Canada. Clim. Change 7:55-69.

This paper concludes that climatic warming would improve productivity in northern Alberta, but would reduce productivity in southern areas because of increased moisture stress based on a dry-matter productivity index. The warmer conditions could potentially result in an 18% net increase in productivity. (Location: Alberta)

Key words: Climate and related effects, tree-crop production

Willoughby, M.G. 1995. The effects of grazing on deciduous plant communities in the boreal ecoprovince of Alberta. Pages 608-609 in N.E. West, comp. Rangelands in a sustained biosphere. Proc. Fifth Int. Rangeland Congr., July 23-28, 1995, Salt Lake City, Utah. Soc. Range Manage., Denver, Colorado.

This study reports the effects of grazing on species composition of aspen/rose stands. The article identifies five distinctive types of vegetation that resulted due to different levels of grazing pressure. Changes in the vegetation included structural and compositional differences. The author considers a maximum-use rate of 25% to maintain the vegetation in good condition. (Location: Northern Alberta)

Key words: Forest grazing, aspen, environmental impacts

Willoughby, M.G.; Sundquist, K.; Downing, D. 1996. Range plant community types and carrying capacity for the dry and central mixed-wood subregions, second approximation.

Alta. Environ. Prot., Land For. Serv., Edmonton, Alberta. Publ. T/395.

A total of 90 range-oriented community-types in the Lower and Mid-Boreal Mixedwood ecoregions of northern Alberta are recognized in this study. These include tame and native grasslands; shrublands; and deciduous, mixed-wood, and coniferous forest types. Individual community-type descriptions identify general management concerns, species composition and average canopy cover, typical site conditions, and a suggested stocking rate. (Location: Northern Alberta)

Key words: Forest grazing, vegetation classification

Winkler, R.D. 1980. Watershed stratification for flow prediction. M.Sc. thesis, Univ. Alta., Edmonton, Alberta.

Winkler, R.D.; Rothwell, R.L. 1983. Biogeoclimatic classification system for hydrologic interpretations. Can. J. For. Res. 13:1043-1050.

The purpose of this study was to determine if biogeoclimatic land classification could be used for hydrologic interpretation. The authors' hypothesis is that the hydrologic recharge and discharge areas can be identified in a watershed by using ecological survey data. The precision of prediction was low, with estimated values exceeding actual values by one to four times. In simple vegetation, the use of biogeoclimatic data does not appear to be an advantage, but it could be of more use in complex landscapes. *Also see Winkler (1980).* (Location: 83 F)

Key words: Ecological land classification, hydrology, vegetation assessment

Wollis, H. 1991. Wildlife and aspen management: a government perspective. Pages 87-91 in S. Navratil and P.B. Chapman, eds. Aspen management for the 21st century. Proc. Symp., November 20-21, 1990, Edmonton, Alberta. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta, and Poplar Counc. Can., Edmonton, Alberta.

Terrestrial birds are used as an example of how species composition changes with vegetation as it develops successional. Aspen

clear-cutting would increase the abundance of early successional birds at the expense of species associated with late-successional stands. (Location: Alberta)

Key words: Vegetation assessment, wildlife distribution and diversity, forest-harvesting effects, birds

Wong, H.R.; Drouin, J.A.; Langor, D.W. 1991. Birch leaf miners. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 5.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of birch leaf miners. (Location: Canada)

Key words: Forest-damage agents, white birch, pest control

Wong, H.R.; Melvin, J.C.E. 1974. Insects of aspen, poplar, and willow catkins in the Canadian prairies. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-76.

The insects associated with male and female aspen catkins are described. The life history of *Epinotia nisella*, *Anathix puta*, and *Dorytomus* spp., the most commonly found species, are also briefly described. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-damage agents, aspen

Wong, H.R.; Melvin, J.C.E. 1976. Biological observations and larval descriptions of *Enargia decolor* (Lepidoptera: Noctuidae) on trembling aspen in northern Alberta. Can. Entomol. 108:1213-1220.

The life history and distribution of *Enargia decolor* is described. This insect often feeds on aspen foliage in late summer. (Location: Northern Alberta)

Key words: Forest-damage agents, aspen

Wong, H.R.; Melvin, J.C.E.; Harper, A.M. 1977. Common insect and mite galls of the Canadian prairies. Fish. Environ. Can., Can. For. Serv., North. For. Res. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-196.

This report pictorially illustrates the more common galls and abnormal growths of the Canadian prairies caused by insects and mites. These growths occur on a variety of native plant species. Dichotomous keys and references are supplied. (Location: Alberta, Saskatchewan, Manitoba)

Key words: Forest-damage agents, jack pine, white birch, aspen, balsam poplar, white spruce, black spruce

Wong, R.K.W.; English, M.; Barlow, F.D.; Cheng, L.; Tremaine, K.R. 1989. Towards a strategy for adapting to climate change in Alberta. Alta. Res. Coun., Resour. Tech. Dep., Edmonton, Alberta.

This study assesses meteorological data from various sites in Alberta with respect to climate change resulting from the greenhouse effect. Results indicate that a 0.2–1.4°C temperature increase had occurred between 1981 and 1987 compared to the 1951–1980 period, but that no detectable change occurred in the amount of precipitation. (Location: Alberta)

Key words: Climate and related effects

Wooley, D.E. 1972. Beaver (*Castor canadensis*) studies in the Mackenzie Valley. Chapter II in R.A. Ruttan and D.R. Wooley, eds. Studies of furbearers associated with proposed pipeline routes in the Yukon and Northwest Territories. Can. Arct. Gas Study Ltd., Calgary, Alberta. Biol. Rep. Ser. 9.

The habitat of beaver is reviewed in several areas in the Northwest Territories. Population size estimates are based primarily on aerial surveys along with some fieldwork. (Location: Northwest Territories)

Key words: Wildlife distribution and diversity, furbearers

Wright, R.A.; Wein, R.W.; Dancik, B.P. 1992. Population differentiation in seedling root size between adjacent stands of jack pine. For. Sci. 38:777–785.

From this field experimental study, the authors find that 14-day-old jack pine grown on wet and dry sites have similar root systems. In the tests, seedlings on wet sites had more tertiary roots at 35 days than did dry sites, possibly

to facilitate oxygen and nutrient uptake during wet periods, while dry-site jack pine might avoid stress with deep-root systems. (Location: 73 H)

Key words: Jack pine, soil and site conditions

Wynnyk, A.; Lindsay, J.D.; Odynsky, W. 1969. Soil survey of the Whitecourt and Barrhead areas. Res. Coun. Alta., Edmonton, Alberta. Alta. Soil Surv. Rep. 90.

In this paper, soils are classified to the series level and mapped at a scale of 1:126 720 (7470 km²). General profile descriptions are provided for each series, and chemical and physical attributes are included for selected profiles. The paper's subgroup classification needs updating. (Location: 83 J)

Key words: Soil survey, soil and site conditions

Xiao, X-J. 1987. Sulfur and its relationship to carbon, nitrogen, and phosphorus in Luvisolic forest soils of Saskatchewan. M.Sc. thesis, Univ. Sask., Saskatoon, Saskatchewan.

This study compares the distribution of sulfur with various soil properties of deciduous, mixedwood, and coniferous boreal forest stands. Cations were most abundant in deciduous stands and decreased with increasing conifer cover. Nitrogen, phosphorus, and sulfur similarly decreased, although total organic matter was similar on all sites. Sulfur decreased with depth, but significant amounts occurred in the upper C horizons. Aspen had the greatest abundance of sulfur. An extensive bibliography is provided. (Location: Saskatchewan)

Key words: Ecology, soil and site conditions, pollution effects

Yanchuk, A.D.; Spilda, I.; Micko, M.M. 1987. Natural variation of extractives in the wood of trembling aspen. Agric. For. Bull. 9(4):22–24.

This study investigates the variation of benzene-alcohol extractives among naturally occurring clones of aspen. Percentage of extractive content shows significant clonal differences; however, clonal heritability indicates that these differences are caused primarily by environmental factors. (Location: Alberta)

Key words: Genetics and cellular structure, economics—fiber, aspen

- Yanchuk, A.D.; Spilda, I.; Micko, M.M. 1988.** Genetic variation of extractives in the wood of trembling aspen. *Wood. Sci. Tech.* 22:67–71.

This study indicates significant differences among clones in terms of their benzene-alcohol-water extractives; however, the heritability for extractive content is considered low. Extractive content was highest near the pith and decreased outwardly. Genetics and phenotypic correlations between rate of growth and extractive content indicate that faster-growing trees tend to exhibit less extractive. (Location: 83 J)

Key words: Genetics and cellular structure, economics—fiber, aspen

- Yang, R.C. 1989.** Growth response of white spruce to release from trembling aspen. *For. Can., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-302.*

This study reviews the effects of aspen overstory removal on white spruce growth. Results suggest that overstory removal stimulates diameter growth (up to 177%), and increases height (42%), basal area, and health of the white spruce. This paper is in part a follow-up to work originally conducted by Steneker (1963, 1967). (Location: Saskatchewan, Manitoba)

Key words: Uneven-aged stand management, juvenile stand-tending, growth and yield, aspen, white spruce

- Yang, R.C. 1991a.** Fertilization: a tool for managing aspen in western Canada. *For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Manage. Note 54.*

Fifteen years after fertilization of a forest stand with a combination of nitrogen, phosphorus, and potassium, this paper finds that a double dosage of nitrogen relative to phosphorus and potassium produced a three-fold improvement in volume growth in aspen growth over the control plots. (Location: 63 D)

Key words: Soil and site productivity, growth and yield, aspen, soil and site conditions

- Yang, R.C. 1991b.** Growth of white spruce following release from aspen competition: 35 year results. *For. Chron.* 67:706–711.

In 1951–52, the aspen overstory of a mixed-wood stand was removed to release white spruce. This paper summarizes the results of this experiment based on test-tree remeasurement in 1987. The paper finds that release improved diameter, height, and volume growth. (Location: 83 O, P)

Key words: Juvenile stand-tending, uneven-aged stand management, growth and yield, aspen, white spruce

- Yang, R., comp. 1993.** Aspen management information system. *Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta, and Alta. Environ. Prot., Alta. Land For. Serv., Edmonton, Alberta. Can.-Alta. Partnership Agreement For. Rep.*

This is a personal-computer data base on aspen management and use with over 7000 published sources. Citations can be accessed by key words that are grouped according to five broad categories: aspen characteristics, ecology, utilization, management, and protection. (Location: Canada)

Key words: Aspen, ecology, soil and site conditions, forest-damage agents, growth and yield, even-aged stand management, fire ecology, economics—fiber

- Yang, R.C.; Bella, I.E. 1994.** Releasing white spruce from trembling aspen: a yield analysis. *Nat. Resour. Can., Can. For. Serv., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Manage. Note 60.*

This study assesses the implications of thinning aspen stands to improve white spruce volume growth. The plots of this analysis were established in 1951–52. Data indicate that removal of aspen could result in increased white spruce volume that is equal to or exceeds the amount expected for the aspen. The largest gains from thinning occurred before the parent stand reached 65 years old. (Location: 83 O)

Key words: Economics—fiber, growth and yield, vegetation control—mechanical, uneven-aged stand management, aspen, white spruce

Young, G.B. 1979. The selection, falling, measurement, weighting and subsampling of the main commercial species within the prairies and Northwest Territories, phase I. Environ. Can., Can. For. Serv., Hull, Quebec. ENFOR Proj. P-92.

For this study, 420 trees (subalpine fir, white spruce, jack pine, aspen, lodgepole pine, and balsam fir) were cut and their biomass was sampled. A total of 20 aspen were sampled in each province. The primary emphasis is on the bole (disks removed), but subsamples were made of cones, branches, and foliage. (Location: Alberta, Saskatchewan, Manitoba, Northwest Territories)

Key words: Growth and yield, balsam fir, white spruce, jack pine, aspen, lodgepole pine

Young, G.B. 1980. The selection, falling, measurement, weighting and subsampling of the main commercial species within the prairies and NWT, phase II. Environ. Can., Can. For. Serv., Hull, Quebec. ENFOR Proj. P-92.

For this study, 180 trees (balsam poplar, tamarack, white birch) were cut and sampled for biomass. A total of 20 trees per species were sampled in each province. The primary emphasis is on the bole (disks removed), but subsamples were made of cones, branches, and foliage. (Location: Alberta, Saskatchewan, Manitoba, Northwest Territories)

Key words: Growth and yield, balsam poplar, white birch

Young, W. 1974. The resource and forest management policy—British Columbia. Pages 17–23 in R.W. Neilson and C.F. McBride, eds. Poplar utilization symposium. Proc., May 23–24, 1974, Edmonton, Alberta. Can. Dep. Environ., Can. For. Serv., West. For. Prod. Lab., Vancouver, British Columbia. Inf. Rep. VP-X-127.

The author indicates that aspen represented more than 50% of the total deciduous forest resource in British Columbia at the time of this study. The majority of this occurred in the northeastern portion of the province. Several general policies on the use of aspen and balsam poplar are briefly mentioned. (Location: British Columbia)

Key words: Economics—fiber, tree-crop production, balsam poplar, aspen, forest policy

Zalasky, H. 1968. Penetration and initial establishment of *Nectria galligena* in aspen and peachleaf willow. Can. J. Bot. 46:57–60.

This study investigates the initial penetration of the periderm and leaf traces by *Nectria galligena* and the early disease symptoms. Results reveal that *Nectria* penetrates the periderm directly; however, the infection establishes itself in the petiole base and leaf trace more rapidly than in the periderm. (Location: Manitoba)

Key words: Forest-damage agents, aspen

Zalasky, H. 1975. Cell deformities in bark and sapwood caused by *Rhytidiella moriformis* and *Keissleriella emergens* infections in poplar. Can. J. Bot. 53:780–783.

This study examines rough-bark and woody galls on balsam poplar using a new histological method of induced infections to ascertain if different symptoms are a reflection of different cell reactions. The author concludes that both pathogens, *R. moriformis* and *K. emergens*, caused changes in cell structure and tissues of the host. It appears, however, that the trees infected with *R. moriformis* resulted in larger affected-surface areas of bark and sapwood than did trees infected with *K. emergens*. (Location: Manitoba)

Key words: Forest-damage agents, balsam poplar

Zalasky, H.; Hiratsuka, Y. 1992. Frost damage of poplar. For. Can., Northwest Reg., North. For. Cent., Edmonton, Alberta. For. Leaflet. 20.

This leaflet summarizes factors such as distribution and hosts; symptoms and damage; causal agent; and prevention and control of frost damage of poplar. (Location: Canada)

Key words: Forest-damage agents, balsam poplar, aspen, pest control

Zoladeski, C.A.; Wickware, G.M.; Dolorme, R.J., Sims, R.A.; Corns, I.G.W. 1995. Forest ecosystem classification for Manitoba: field guide. Nat. Resour. Can., Can. For. Serv., Northwest

**Reg., North. For. Cent., Edmonton, Alberta.
Spec. Rep. 2.**

This paper discusses 33 vegetation types in the boreal forest portion of Manitoba. General descriptions are provided of species composition and site conditions. In addition, 22 generalized soil types are presented, based on moisture conditions and texture. The relationships among vegetation type, soil types, and moisture/nutrient regimes are described in both graphical and tabular formats. (Location: Manitoba)

Key words: Vegetation classification, soil and site conditions, land evaluation

Zoltai, S.C. 1969. Geomorphology of the Waterhen River area, Saskatchewan. Can. Dep. Fish. For., For. Branch, Winnipeg, Manitoba. Inf. Rep. MS-X-19.

The geomorphology of the Waterhen area is mapped and interpreted at a 1:250 000 scale, and major climatic zones are delineated. In addition, a general summary is provided to

explain the geomorphic history of the area. (Location: 73 K)

Key words: Physical land classification and geology, ecological land classification

Zoltai, S.C.; Strong, W.L. comp. 1989. Ecoclimatic regions of Canada. Environ. Can., Can. Wildl. Serv., Can. Committee Ecol. Land Classif., Ecoregions Working Group, Ottawa, Ontario. Ecol. Land Classif. Ser. 23.

An ecologically based climatic zonation for Canada is presented. The criteria for ecoclimatic-zone recognition are based on vegetation growing on normal sites (i.e., moderately well-drained loam soils with neither an excess nor lack of nutrients, and neither exposed nor protected from local climatic extremes). Most of Rowe's (1972) B.18a and B.18b forest sections occurred in the Subhumid Low and Mid Boreal ecoclimatic regions. (Location: Canada)

Key words: Ecological land classification, climate and related effects

INDEX TO REFERENCES BY GEOGRAPHICAL LOCATION

North America

Burns and Honkala 1990; Peterson and Peterson 1994; Timmermann and McNicol 1988.

United States

Kimmins 1975; Kimmins and Fraker 1973; Vaartaja 1960.

Canada

Argus and Pryer 1990; Bonnor 1982; Brandt 1994a, b; Caltrell and Amirault 1991; Cerezke 1991a, b, c, 1992, 1994a; Corns 1989; Drouin et al. 1991; Drouin and Langor 1991, 1992; Fillion et al. 1983; Fleming and Volney 1995; Hildahl and Hiratsuka 1991; Hiratsuka 1994; Hiratsuka and Maruyama 1991; Ip 1992; Jozsa et al. 1984; Kimmins 1975; Kimmins and Fraker 1973; Kurz and Apps 1993, 1994; Kurz, Apps, Beukema, and Lekstrum 1995; Kurz, Apps, Stocks, and Volney 1995; Kusch and Cerezke 1991a, b; Kusch and Langor 1992; Langor 1995; Maini 1968; Mallett 1994; Manning and Grinnell 1971; Maruyama 1991; Maruyama and Hiratsuka 1991; Miller and Auclair 1974; Myrholm and Cerezke 1994; Navratil and Chapman 1991; Peterson et al. 1983; Rowe 1972; Rowe and Scotter 1973; Singh and Higginbotham 1988; Smith and Crook 1996; Strong et al. 1990; Telfer 1974, 1984; Tidsbury et al. 1992; Volney 1988b, 1989, 1994, 1995, 1996; Weetman 1983; Wein and MacLean 1983; Wiken 1986; Wong et al. 1991; Yang 1993; Zalasky and Hiratsuka 1992; Zoltai and Strong 1989.

Alberta

Abouguendia and Godwin 1980; Achuff 1992; Alberta Energy and Natural Resources 1984a, b; Alberta Environmental Centre 1981; Apps et al. 1993; Beckingham 1991; Beckingham and Archibald 1996; Bella and De Franceschi 1980b; Blennis et al. 1995; Bonan et al. 1992; Brace 1991; Brace and Bella 1988; Brown and Navratil 1995; Campbell et al. 1969; Cerezke 1994b; Cheliak 1980; Cheliak and Dancik 1982; Cieszewski and Bella 1991; Dancik et al. 1990; D.A. Westworth and Associates Ltd. 1990; Delisle and Hall 1987; Denney 1988; Digweed 1995; Drouin and Kusch 1976, 1977, 1979, 1980; Ealey 1987; Eberhart 1988; Eberhart and Woodard 1987; Ehrentraut and Branter 1990; Ellis

1986; Erskine 1977; Fisher 1982; Fregren 1980; Gorman 1985; Gould 1999; Grabowski et al. 1981; Gullion 1986; Hall et al. 1984; Hardy Associates (1979) Ltd. 1981; Henderson 1987; Hildahl and Campbell 1975; Hiratsuka 1987; Hiratsuka and Loman 1984; Hiratsuka et al. 1990, 1995; Hogg 1994; Hogg and Hurdle 1995; Holowaychuk and Fessenden 1987; Howlett 1989; Huang 1994a, b, c, d, e, f, g, 1996; Huang, Lakusta, and Giacobbo 1994; Huang, Lakusta, and Held 1994; Huang and Titus 1995, 1996; Huang, Titus, and Lakusta 1994; Huang, Titus, Lakusta, and Held 1994; Hudson 1975; IEC Beak Consultants Ltd. 1984; Ives 1973; Ives and Wong 1988; Jackson 1974; Jarvis 1968; Jarvis et al. 1966; Johnson 1987; Johnson et al. 1971; Kelsall et al. 1977; Knapik and Westworth 1984; Knight 1967; Kojima 1980; Krämer 1972; Krumlik et al. 1978; Kurz and Apps 1995; Laidlaw 1974; Lakusta 1988; Langor et al. 1992; La Roi and Ellis 1984; Lees 1960, 1962b, 1966; Lewis 1977; Lieffers et al. 1996; Loman et al. 1972; MacIsaac and Navratil 1996; MacIver et al. 1972; Malhotra and Blauel 1980; Malik and Vander Born 1986; Mallett 1990, 1992; McDonald 1979; McLaughlin and Dumas 1996; Moss 1953, 1955; Murphy 1988; Navratil 1995, 1996a, c; Navratil and MacIsaac 1993; Navratil et al. 1989, 1990; Nielson 1975; Nietfeld and Hudson 1985; Nietfeld et al. 1985; Packer and Bradley 1984; Penner and Associates Ltd. 1991; Peterson 1970; Peterson and Peterson 1992; Peterson et al. 1982; Phillips et al. 1986; Ponto 1990; Powell and MacIver 1977, 1978; Pringle et al. 1973; Prokopchuk and Archibald 1976; Reid 1977; Rothwell 1978; Rowe 1956b; Russell 1986; Russell et al. 1984; Semenchuk 1992; Singh 1982a, b, 1984b, 1986, 1987; Singh, comp. 1988; Singh and Hillman 1972; Singh and Wheaton 1991; Smith 1978; Spence et al. 1996; Stelfox (J.B.) 1989; Stelfox (J.G.) et al. 1973; Stelter 1985; Stenecker 1976; Stenecker and Wall 1970; Strong 1992; Strong and Leggat 1981, 1992; Strong and Thompson 1995; Sunquist et al. 1997; Trottier 1980; Van Kooten and Arthur 1988; Wallis 1987; Wheaton et al. 1987; Williams 1985; Willoughby 1995; Willoughby et al. 1996; Wollis 1991; Wong and Melvin 1974, 1976; Wong et al. 1977; Wong et al. 1989; Yanchuk et al. 1987; Young 1979, 1980.

British Columbia

Grant 1980; Young 1974.

Manitoba

Apps et al. 1993; Basham 1987; Bella 1970; Bella and De Franceschi 1980b; Bella and Jarvis 1967; Bonan et al. 1992; Brace 1991; Brace and Bella 1988; Campbell et al. 1969; Cerezke 1994b; Erskine 1977; Gorman 1985; Grabowski et al. 1981; Gullion 1986; Hildahl and Campbell 1975; Hildahl and Reeks 1960; Hiratsuka 1987; Hiratsuka et al. 1995; Hogg 1994; Hogg and Hurdle 1995; Howlett 1989; Ives 1973, 1981; Ives and Wong 1988; Jarvis 1968; Jarvis et al. 1966; Johnson 1985; Kelsall et al. 1977; Kolabinski 1969c; Krämer 1972; Kurz and Apps 1995; Langor et al. 1992; Liefers et al. 1996; MacIsaac and Navratil 1996; Malhotra and Blauel 1980; Malik and Vander Born 1986; Mallett 1990, 1992; McLaughlin and Dumas 1996; Navratil 1995; Navratil et al. 1990; Peterson and Peterson 1992; Peterson et al. 1982; Phillips et al. 1986; Powell and MacIver 1977, 1978; Rannard 1974; Robertson 1994; Rowe 1955, 1956a, b; Singh 1982a, b, 1984b, 1986, 1987; Singh and Wheaton 1991; Smith 1978; Steneker 1963, 1967, 1976; Steneker and Wall 1970; Steneker and Walters 1971; Trottier 1980; Van Kooten and Arthur 1988; Volney 1988a; Waldron 1964; Wall 1969, 1971; Wheaton et al. 1987; Wong and Melvin 1974; Wong et al. 1977; Yang 1989; Young 1979, 1980; Zalasky 1968, 1975; Zoladeski et al. 1995.

Northwest Territories

Crampton 1973; Jeffery 1964; Johnson 1987; Reid 1974; Singh 1983, 1984a; Singh and Hillman 1972; Thomas and Wein 1990; Wooley 1972; Young 1979, 1980.

Ontario

Basham 1987; MacDonald 1996.

Saskatchewan

Abouguendia et al. 1986; Apps et al. 1993; Bella 1970; Bella and De Franceschi 1980b; Bonan et al. 1992; Boyd 1978; Brace 1991; Brace and Bella 1988; Campbell et al. 1969; Cerezke 1994b; Drouin and Kusch 1975; Ellis and Clayton 1970; Erskine 1977; Gál and Bella 1994; Gorman 1985; Grabowski et al. 1981; Gullion 1986; Hall and Aldred 1992; Harris 1980; Harris et al. 1983; Hildahl and Campbell 1975; Hildahl and Reeks 1960; Hiratsuka 1987; Hiratsuka et al. 1995; Hogg 1994; Hogg and Hurdle 1995; Howlett 1989; Hunt 1978; Ives 1973, 1981; Ives and Wong 1988; Jarvis 1968; Jarvis et al. 1966; Jesberger and Sheard 1973; Johnson 1985; Kabzems 1952, 1971; Kabzems et al. 1986; Kagis 1952; Kelsall et al.

1977; Kirby et al. 1957; Kolabinski 1969a, b; Krämer 1972; Krause et al. 1982; Kurz and Apps 1995; Langor et al. 1992; Leblanc and Sutherland 1987; Liefers et al. 1996; Loseth et al. 1990; Maher et al. 1979; Malhotra and Blauel 1980; Malik and Vander Born 1986; Mallett 1990, 1992; McLaughlin and Dumas 1996; Miller 1974; Morrall 1974; Navratil 1995; Navratil et al. 1990; Padbury 1986; Peterson and Peterson 1992; Peterson et al. 1982; Phillips et al. 1986; Powell and MacIver 1977, 1978; Roberts 1986; Rowe 1955, 1956a, b; Sidhu 1965; Singh 1982a, b, 1984b, 1986, 1987; Singh and Powell 1986; Singh and Wheaton 1991; Smith 1978, 1989; Steneker 1967, 1976; Steneker and Wall 1970; Thorpe 1991; Trottier 1980; Van Groenewoud 1961; Van Kooten and Arthur 1988; Volney 1988a; Wheaton et al. 1987; Wong and Melvin 1974; Wong et al. 1977; Xiao 1987; Yang 1989; Young 1979, 1980.

52 E (Kenora sheet)

Cayford et al. 1959; Drouin 1989.

52 L (Point Du Bois sheet)

Drouin 1989; MacIsaac 1995.

52 M (Carroll Lake sheet)

Dyck 1994.

53 D (Roseau sheet)

Dyck 1994.

62 F (Virden sheet)

Steneker 1966, 1974c; Steneker and Jarvis 1966.

62 I (Cross Lake sheet)

MacIsaac 1995.

62 K (Riding Mountain sheet)

Ball 1990; Bella 1968; Bella and Hunt 1973; Cayford et al. 1959; De Franceschi 1969; Halliday 1935; Jameson 1963; Jarvis and Tucker 1968a, b; Johnson 1957; Johnson and Waldron 1992; Kolabinski 1965; Pratt 1966; Steneker 1964, 1972, 1973, 1974a, c; Steneker and Jarvis 1966; Steneker and Prasad 1972; Tucker and Jarvis 1967; Waldron and Kolabinski 1994.

62 N (Duck Mountain sheet)

De Franceschi and Bell 1990; Dyck 1994; Johnson 1957, 1986; Knapik et al. 1988; Kolabinski 1994; MacIsaac 1995; Pike 1953; Schewe and Stewart

1986; Stenecker and Jarvis 1966; Waldron and Kolabinski 1994.

62 O (Dauphin Lake sheet)

Ball and Walker 1995; Dyck 1994.

62 P (Hecia sheet)

Dyck 1994.

63 A (Berens River sheet)

Dyck 1994.

63 B (Waterhen Lake sheet)

Ball and Walker 1995; Dyck 1994.

63 C (Swan Lake sheet)

Dyck 1994; Johnson 1957; Stenecker 1969a; Stenecker and Wall 1972; Stonehouse and Ellis 1983; Wall et al. 1971.

63 D (Hudson Bay sheet)

Beckingham, Nielson, and Futoransky 1996; Bella 1968; Bella and De Franceschi 1980a; Froning 1980; Hunt 1976; Kolabinski 1965, 1994; Maynard and Fairbarns 1994; Stenecker and Jarvis 1963, 1966; Stewart et al. 1977; Stonehouse and Ellis 1983; Yang 1991a.

63 E (Pasquia Hills sheet)

Ayres et al. 1978; Ball and Kolabinski 1979; Beckingham, Nielson, and Futoransky 1996; Bella 1972, 1975, 1986a; Bella and De Franceschi 1972, 1980a; Flannigan and Van Wagner 1991; Halliwell et al. 1995; Kolabinski 1994; Saskatchewan Power Corporation 1977; Shoup 1970; Stewart et al. 1977.

63 F (The Pas sheet)

Ayres et al. 1978; Bella and Hunt 1973; MacIsaac 1995.

63 K (Cormorant Lake sheet)

MacIsaac 1995.

63 L (Amisk Lake sheet)

Halliwell et al. 1995.

72 J (Swift Current sheet)

Cessna et al. 1989; Waddington and Bittman 1987.

73 B (Saskatoon sheet)

Drouin and Wong 1975; Pylpec and Redmann 1984.

73 E (Vermilion sheet)

Downing and Karpuk 1992; Elhert and Downing 1994; Hardy Associates (1979) Ltd. 1979; Kocaoglu and Bennett 1983.

73 F (St. Walburg sheet)

Beckingham, Nielson, and Futoransky 1996; Rostad and Ellis 1972; Thorpe 1978.

73 G (Shellbrook sheet)

Beckingham, Nielson, and Futoransky 1996; Bella and De Franceschi 1980a; Crosson et al. 1970; Donald et al. 1993; Padbury et al. 1978; Parry, Volney, and Currie 1997.

73 H (Prince Albert sheet)

Anderson 1976; Anderson and Ellis 1976; Ball and Kolabinski 1986; Beckingham, Nielson, and Futoransky 1996; Bella and De Franceschi 1980a; Cayford 1957; Chrosciewicz 1988; Dix and Swan 1971; Hall et al. 1995; Halliwell et al. 1995; Jones 1978; Kabzems and Senyk 1967; Kirby 1962; Kolabinski 1965, 1994; Mallett and Volney 1990; Maynard and Fairbarns 1994; Morrall 1964; Morrall and Vanterpool 1968; Pennock et al. 1996; Santo 1984; Swan and Dix 1966; Vaartaja 1960; Waldron and Kolabinski 1994; Wright et al. 1992.

73 I (Wapawekka sheet)

Archibold 1979, 1980; Halliwell et al. 1995; Head et al. 1981.

73 J (Green Lake sheet)

Beckingham, Nielson, and Futoransky 1996; Padbury et al. 1978; Stenecker 1974b.

73 K (Waterhen River sheet)

Beckingham, Nielson, and Futoransky 1996; Bella and De Franceschi 1980a; Zoltai 1969.

73 L (Sand River sheet)

Alberta Energy and Natural Resources 1985d; Alberta Environmental Protection 1996a; Bella and De Franceschi 1980a; Boyacioglu 1974; Chesterman and Stelfox 1995; Crampton 1995; Crampton and Barclay 1995; Crites and Dale 1995; Downing and

Karpuk 1992; Elhert and Downing 1994; Fenton and Andriashek 1983; Hammond 1996; Hardy Associates (1979) Ltd. 1979; Hay et al. 1985; Kocaoglu 1975; Landhausser and Lieffers 1997; Lee, Crites, Nietfeld, Van Nguyen, and Stelfox 1995; Lee, Crites, and Stelfox 1995; Lee, Crites, Sturgess, and Stelfox 1995; McDonald 1995; Ojamaa 1978a; O'Leary 1986; Parry 1995; Peterson et al. 1988a, b; Roy et al. 1995; Schieck and Nietfeld 1995; Schieck and Roy 1995; Spence and Langor 1994; Stelfox (J.B.) et al. 1995; Strong 1978; Tietje and Ruff 1980; Usher 1978, 1981.

73 M (Winefred sheet)

Alexander et al. 1983; Bella and De Franceschi 1980a; Cumming et al. 1995; Hall et al. 1983; Singh 1988; Strong 1988; Weaver 1996.

73 N (Buffalo Narrows sheet)

Beckingham, Nielson, and Futoransky 1996; Campbell and Dunfield 1969; Hall et al. 1983.

73 P (Lac La Ronge sheet)

Cumming et al. 1995; Navratil et al. 1996; Navratil and MacIsaac 1996.

74 A (Upper Foster Lake sheet)

Cumming et al. 1995.

74 C (La Loche sheet)

Beckingham, Nielson, and Futoransky 1996; Hall et al. 1983.

74 D (Fort McMurray sheet)

Addison 1980, 1982, 1984; Addison and Puckett 1980; Addison et al. 1986; Alberta Environmental Protection 1996b; Baker et al. 1977; Bayrock and Reimchem 1974; Cumming et al. 1995; Downing and Legris 1988; Eulert and Hernandez 1980; Francis and Lumbis 1979; Fuller and Keith 1980a, b, 1981; Gilbert and Nancekirell 1982; Gill 1974; Green 1980a, b; Hall et al. 1983; Hanley 1973; Hauge and Keith 1981; Hennan and Munson 1979; Intera Consultants Ltd. 1975; Jaques and van Eck 1980; L'Hirondelle et al. 1986; Lieffers and Campbell 1984; Lindsay et al. 1957; Malhotra et al. 1980; Murray 1981; Nowlin 1978; Penner et al. 1980; Pielou et al. 1986; Roberts and Lewin 1979; Rowan and Keith 1956; Searing 1979; Stringer 1976; Strong 1988; Syncrude Canada Ltd. 1973; Thompson et al. 1978, 1980; Turchenek and Lindsay 1982.

74 E (Bitumount sheet)

Addison 1980, 1982, 1984; Addison and Puckett 1980; Addison et al. 1986; Alberta Environmental Protection 1996b; Baker et al. 1977; Bayrock 1971; Bovar Environmental 1996; Campbell et al. 1985; Cumming et al. 1995; Eulert and Hernandez 1980; Francis and Lumbis 1979; Fuller and Keith 1980a, b, 1981; Gilbert and Nancekirell 1982; Gill 1974; Green 1980a, b; Hardy Associates (1978) Ltd. 1980; Hennan and Munson 1979; Intera Consultants Ltd. 1975; L'Hirondelle et al. 1986; Lieffers and Campbell 1984; Loman and Associates 1976; Malhotra et al. 1980; Murray 1981; Nowlin 1978; Parker 1978; Penner et al. 1980; Peterson and Levinsohn 1977; Pielou et al. 1986; Roberts and Lewin 1979; Searing 1979; Stringer 1976; Strong 1988; Syncrude Canada Ltd. 1973; Thompson et al. 1978, 1980; Turchenek and Lindsay 1982; Twardy 1978.

74 F (Lloyd Lake sheet)

Beckingham, Nielson, and Futoransky 1996.

74 H (Geikie River sheet)

Cumming et al. 1995.

74 L (Fort Chipewyan sheet)

Airphoto Analysis Associates 1979; Bayrock 1972a; Novakowski 1967; Penner et al. 1980; Stringer 1976; Strong 1988; Turchenek and Lindsay 1982.

74 M (Fitzgerald sheet)

Airphoto Analysis Associates 1979; Bayrock 1972c.

82 G (Ferne sheet)

Archibald et al. 1996; Swanson and Stevenson 1971.

82 H (Lethbridge sheet)

Archibald et al. 1996.

82 J (Kananaskis Lakes sheet)

Archibald et al. 1996.

82 N (Golden sheet)

Archibald et al. 1996; Rayner 1984.

82 O (Calgary sheet)

Annas et al. 1983; Archibald 1982; Archibald et al. 1996; Beke 1969; MacDonald and Lieffers 1991; Quintilio et al. 1991; Rayner 1984; Stelfox (H.) 1981.

83 B (Rocky Mountain House sheet)

Addison et al. 1984; Alberta Forestry, Lands and Wildlife 1986a, b, c; Archibald 1981, 1982; Archibald et al. 1996; Baker et al. 1977; Beckingham, Corns, and Archibald 1996; Bella 1986b; Bella and Gál 1996; Boydell et al. 1974; D.A. Westworth and Associates Ltd. 1981; Dutchak 1982, 1984; Gower 1989; IEC Beak Consultants Ltd. 1985; Kocaoglu 1983; Kocaoglu and Sauchyn 1980; Leskiw et al. 1984; Lindsay et al. 1968; Maynard 1990; Maynard et al. 1994; Navratil and MacIsaac 1996; Parry 1995; Peters 1981; Peters and Bowser 1956; Rayner 1984; Sauder 1992; Singh 1988; Spence and Langor 1994; Strong and Kennedy 1986a, b; Tomm 1978; Tomm et al. 1981; Wehrhahn 1981; Westworth et al. 1984.

83 C (Brazeau sheet)

Alberta Forestry, Lands and Wildlife 1986a, b, 1990; Archibald 1981, 1982; Archibald et al. 1996; Beckingham, Corns, and Archibald 1996; Bentz, Brierley, Hay, Nelson, Robertson, and Wehrhahn 1985; Dutchak 1982, 1984; Kocaoglu 1983; Kocaoglu and Sauchyn 1980; Lehn 1979, 1980; Lehn and Higginbotham 1982; Rayner 1984; Tomm 1978; Wehrhahn 1981, 1982.

83 E (Mountain Robson sheet)

Beckingham, Corns, and Archibald 1996; Case 1977; Corns and Annas 1986; Ferguson 1980a, b; Nelson et al. 1988.

83 F (Edson sheet)

Alberta Forestry, Lands and Wildlife 1986a, 1990; Anderson 1980; Baker 1973; Beckingham, Corns, and Archibald 1996; Bella 1986b; Bella and Gál 1996; Bentz, Brierley, Hay, Nelson, Robertson, and Wehrhahn 1985; Bentz, Johnson, and Brierley 1985; Boyacioglu and Van Waas 1973; Brace 1990; Brace Forest Services 1992; Case 1977, 1978; C.D. Schultz and Company Ltd. 1973; Corns 1972; Corns and Annas 1986; Corns and La Roi 1976; Drouin 1989; Dumanski et al. 1972; Dutchak 1982; Ferguson 1980a, b; Krumlik et al. 1982; MacCallum and Ebel 1984; Navratil et al. 1994; Nelson et al. 1988; Roed 1970; Sauder 1992; Singh and Kalra 1977; Stelfox (J.G.) 1981, 1984, 1988; Stelfox (J.G.) et al. 1976; Strong 1988; Swanson and Hillman 1977a, b; Taylor

et al. 1989b; Tomm 1978; Tomm et al. 1981; Van Waas 1978; Wehrhahn 1981; Weldwood of Canada Limited 1990; Winkler and Rothwell 1983.

83 G (Wabamun Lake sheet)

Alberta Forestry, Lands and Wildlife 1986a; Archibald 1981; Bella 1986b; Bella and Gál 1996; Brace 1990; Case 1977, 1978; Drouin and Wong 1975; Dutchak 1982, 1984; Howitt 1981; Kocaoglu 1983; Kocaoglu and Sauchyn 1980; Lesko and Lindsay 1973; Lindsay et al. 1968; Navratil et al. 1996; Ojamaa 1979; Parry 1994; Parry, Spence, and Volney 1997; Peters 1981; Raske 1974; Strong 1996b; Swan and Kellogg 1986; Tomm 1978; Tomm et al. 1981; Twardy and Lindsay 1971; Van Waas 1978; Wehrhahn 1981.

83 H (Edmonton sheet)

Beckingham 1990; Bichlmaier 1985; Bishoff 1981b; Cairns 1976; Cairns and Telfer 1980; Downing and Karpuk 1992; Elhert and Downing 1994; Hilton and Bailey 1974; Jaquish 1981; Johnston 1981; Johnston and Woodard 1985; Kemp and Keith 1970; Moss 1938; Nietfeld 1983; Parry 1995; Pease et al. 1979; Polster and Watson 1979; Regier 1985; Reid 1986; Renecker 1986; Renecker and Hudson 1985, 1986; Rivard et al. 1990; Rolley and Keith 1980; Rusch and Reeder 1978; Skinner 1984; Telfer 1978; Telfer and Cairns 1978; Telfer and Scotter 1969; Van Camp and Telfer 1975a, b.

83 I (Tawatinaw sheet)

Alberta Energy and Natural Resources 1985a; Doerr et al. 1974; Downing and Karpuk 1992; Elhert and Downing 1994; Kil 1970; Kjeirsgaard 1972; Kumar 1973a, b; Peterson et al. 1988a, b; Rusch and Keith 1971.

83 J (Whitcourt sheet)

Alberta Energy and Natural Resources 1985a; Alberta Environmental Protection 1993; Beckingham, Corns, and Archibald 1996; Bella and Gál 1996; Boyacioglu 1975; Brace 1990; Case 1977, 1978; Constabel and Lieffers 1996; Delong 1995; Heidt 1983; Ives et al. 1982; Johnstone and Peterson 1980; Kumar 1973a, b; Lehn 1979, 1980; Lehn and Higginbotham 1982; Lieffers and Stadt 1994; Lieffers, Stadt, and Navratil 1996; Macdonald et al. 1996; MacLeod and Blyth 1955; Maier and Darrah 1989; Marsden 1995; Marsden et al. 1996; Montero 1994; Mytton and Keith 1981; Nelson et al. 1989; Pearson 1976; Peterson et al. 1988a; Sauder 1992; Schmidt et al. 1996; Strong 1988; Thomas et al. 1960;

Tomm 1978; Tomm et al. 1981; Urban et al. 1994; Van Waas 1978; Vega Garcia 1994; Weatherill and Keith 1969; Wynnyk et al. 1969; Yanchuk et al. 1988.

83 K (Iosegun sheet)

Alberta Forestry, Lands and Wildlife 1988, 1991b; Beckingham, Corns, and Archibald 1996; Bella 1986b; Bessie et al. 1986; Boyacioglu 1975; Boyacioglu and Van Waas 1973; Brace Forest Services 1992; Case 1977, 1978; C.D. Schultz and Company Ltd. 1973; Corns and Annas 1986; Ferguson 1980a; Holland and Nemeth 1974; Johnstone and Peterson 1980; Kansas and Brown 1992; Knapik and Lindsay 1983; Knight and Duffy 1967; Lees 1962a; Macdonald et al. 1996; Maier and Darrah 1989; Montero 1994; Navratil et al. 1994; Nelson 1983; Ojamaa 1978b; Schmidt et al. 1996; Strong 1996a; Thomas et al. 1960; Tomm 1978; Tomm et al. 1981; Van Waas 1978.

83 L (Wapiti sheet)

Alberta Forestry, Lands and Wildlife 1991a; Archibald et al. 1984; Beak Associates Consulting Ltd. 1986; Beckingham, Corns, and Archibald 1996; Bella 1986b; Case 1977; Corns 1978, 1983; Corns and Annas 1986; Drouin 1989; Feng et al. 1989; Ferguson 1980a, b; Gibbard and Sutherland 1987; Holmsen 1988; Knapik et al. 1985; Lees 1965; Maynard 1993; Navratil et al. 1996; Navratil and MacIsaac 1996; Penner 1990; Schneider 1988; Sidhu and Feng 1991, 1993; Sidhu et al. 1994; Strong, Navratil, Sidhu, and Thompson 1995; Strong, Sidhu, and Navratil 1995; Thomas et al. 1960; Tomm 1978; Tomm et al. 1981; Twardy and Corns 1980; Wheeler and Willoughby 1993.

83 M (Grande Prairie sheet)

Alberta Forestry, Lands and Wildlife 1987a, 1991a; Archibald 1986; Beckingham, Corns, and Archibald 1996; Carder 1972; Case 1977; Downing and Bennett 1984; Gibbard and Sutherland 1987; Luck 1982; Navratil and MacIsaac 1996; Nelson 1983; O'Leary and Downing 1986a, b; Park and Bennett 1983; Schultz et al. 1986; Strong 1990; Tomm 1978; Tomm et al. 1981.

83 N (Winagami sheet)

Alberta Forestry, Lands and Wildlife 1987c, d; Archibald 1986; Case 1977; Kumar 1975; Nelson 1983; Parry 1995; Schultz et al. 1986; Strong 1988, 1990; Synergy West Ltd. 1977; Thomas et al. 1960.

83 O (Lesser Slave Lake sheet)

Alberta Energy and Natural Resources 1985a, b; Archibald 1986; Bella and De Franceschi 1980a; Bella and Gál 1996; Bishoff 1984; Case 1977; Drouin 1989; Duffy 1963, 1965; Duffy and Nemeth 1965, 1967; Flanagan and Moser 1985; Grewal 1988, 1995; Hansen 1995; Ives and Muldrew 1978; Ives et al. 1982; Johnson and Gorman 1977; Johnstone and Peterson 1980; Kumar 1973a; La Roi 1992; La Roi and Ostafichuk 1982; Lees 1963, 1964, 1965, 1970a, b; MacLeod and Blyth 1955; Parry 1995; Paul and Etheridge 1958; Peterson et al. 1988a; Quaite 1953; Ross et al. 1986; Ross and La Roi 1984; Singh 1988; Smithers 1959; Spence and Langor 1994; Strong 1982, 1984, 1988; Strong and La Roi 1983a, b, 1985; Swan and Kellogg 1986; Synergy West Ltd. 1977; Taylor et al. 1989a; Thomas et al. 1960; Yang 1991b; Yang and Bella 1994.

83 P (Pelican sheet)

Alberta Energy and Natural Resources 1985a; Bella and De Franceschi 1980a; Chesterman and Stelfox 1995; Cotterill 1996; Crampton 1995; Crampton and Barclay 1995; Crites and Dale 1995; Drouin 1989; Duffy 1965; Duffy and Nemeth 1965, 1967; Gill 1974; Grewal 1988, 1995; Hansen 1955; Hay and O'Leary 1988; Hogg and Lieffers 1991a, b, c; Kumar 1973a; Lee, Crites, Nietfeld, Van Nguyen, and Stelfox 1995; Lee, Crites, and Stelfox 1995; Lee, Crites, Sturgess, and Stelfox 1995; Lees 1965; Machtans 1996; MacIsaac 1986; MacLeod and Blyth 1955; McDonald 1995; Navratil and Lane 1987; Peterson et al. 1988a; Powelson and Lieffers 1991; Rintoul and Myer 1983; Roy et al. 1995; Schieck and Nietfeld 1995; Schieck and Roy 1995; Stelfox (J.B.) et al. 1995; Strong 1988; Swan and Kellogg 1986; Taylor et al. 1989a; Yang 1991b.

84 A (Algar Lake sheet)

Fuller and Keith 1980b, 1981; Lindsay et al. 1957; Penner et al. 1980; Stringer 1976; Thompson et al. 1978.

84 B (Peerless Lake sheet)

Archibald 1986; Case 1977; Cumming et al. 1995; Hansen 1995; Lindsay et al. 1957.

84 C (Peace River sheet)

Alberta Forestry, Lands and Wildlife 1987c; Archibald 1986; Beckingham, Corns, and Archibald 1996; Bulmer 1987; Case 1977; Downing et al. 1986, 1987; Edgar et al. 1986; Ghitter et al. 1995b; Hall and

Klita 1997; Johnson and Gorman 1977; Kansas et al. 1991; Lindsay et al. 1957; Navratil and Lane 1987; Navratil et al. 1996; Ojamaa 1977b, 1978c; O'Leary et al. 1986; Parry 1995; Scheelar and Odynsky 1968; Schultz et al. 1986; Spence and Langor 1994; Synergy West Ltd. 1977; Van Waas 1977a, b.

84 D (Clear Hills sheet)

Archibald 1986; Beckingham, Corns, and Archibald 1996; Brocke 1976; Case 1977; Hammond 1996; Holland and Nemeth 1974; Kansas et al. 1991; Lindsay et al. 1958; Navratil and Lane 1987; Navratil et al. 1996; Reeder and Odynsky 1965; Schultz et al. 1986; Van Waas 1977b, Van Waas and Boyacioglu 1973.

84 E (Chinchaga River sheet)

Archibald 1986; Beckingham, Corns, and Archibald 1996; Gibbard and Sutherland 1987; Holland and Nemeth 1974; Lindsay et al. 1958; Navratil et al. 1994.

84 F (Bison Lake sheet)

Alberta Forestry, Lands and Wildlife 1987b; Archibald 1986; Brierley et al. 1985; Downing et al. 1987; Dutchak 1979; Franklin et al. 1995; Ghitter et al. 1995a, b; Hall and Klita 1997; Lindsay et al. 1958; Reeder and Odynsky 1969; Volney and Cerezke 1992.

84 G (Waldin Lake sheet)

Archibald 1986; Cameron 1977; Cumming et al. 1995; Giberson 1988; Lindsay et al. 1958.

84 H (Namur Lake sheet)

Ealey 1979; Fuller and Keith 1980b, 1981; Lindsay et al. 1961; Penner et al. 1980; Stringer 1976; Thompson et al. 1978.

84 I (Lake Claire sheet)

Airphoto Analysis Associates 1979; Bayrock 1972b; Lacate et al. 1965; Lindsay et al. 1961.

84 J (Vermilion Chutes sheet)

Alberta Energy and Natural Resources 1985c; Archibald 1986; Bishoff 1981a; Kumar 1977; Lindsay et al. 1959; Scheelar and Macyk 1972; Strong 1981.

84 K (Mount Watt sheet)

Archibald 1986; Ferguson (T.) 1980; Holland and Nemeth 1974; Johnson and Gorman 1977; Kumar 1977; Lindsay et al. 1959; Ojamaa 1977a; Scheelar and Macyk 1972.

84 L (Zama Lake sheet)

Archibald 1986; Ferguson (T.) 1980; Lindsay et al. 1959.

84 M (Bistcho Lake sheet)

Archibald 1986; Ferguson (T.) 1980; Lindsay et al. 1960.

84 N (Steen River sheet)

Archibald 1986; Downing et al. 1986; Ferguson (T.) 1980; Lindsay et al. 1960; O'Leary et al. 1986.

84 O (Whitesand River sheet)

Archibald 1986; Cumming et al. 1995; Lindsay et al. 1960.

84 P (Peace Point sheet)

Airphoto Analysis Associates 1979; Bayrock 1972c; Cordes et al. 1975; Feng and Navratil 1990; Lacate et al. 1965; Lindsay et al. 1961.

85 C (Tathlina Lake sheet)

More 1978.

93 P (Dawson Creek sheet)

Tanner et al. 1996.

94 J (Fontas River sheet)

Annas 1977; Kabzems and Lousier 1992.

94 O (Maxhamish Lake sheet)

Kabzems and Lousier 1992.

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Addison et al. 1984; Brown 1989; Brown and Higginbotham 1986; Cormack 1965; Cormack and Lemay 1966; Dai 1966; Garden and Davies 1988; Landhausser and Lieffers 1994; Landhausser et al. 1996; Macdonald and Lieffers 1993; Stewart and Lieffers 1993, 1994; White 1981.

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Not Specified

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ECOLOGICAL CONSIDERATIONS

Ecology

Anderson 1976; Archibold 1979, 1980; Beckingham 1990, 1991; Bentz, Brierley, Hay, Nelson, Robertson, and Wehrhahn 1985; Case 1977; Cheliak 1980; Cheliak and Dancik 1982; Chesterman and Stelfox 1995; Constabel and Lieffers 1996; Corns 1972, 1978, 1983; Crites and Dale 1995; Dix and Swan 1971; Ellis 1986; Eulert and Hernandez 1980; Flanagan and Moser 1985; Giberson 1988; Halliday 1935; Hammond 1996; Hogg 1994; Hogg and Lieffers 1991a, b, c; Holland and Nemeth 1974; Jeffery 1964; Jesberger and Sheard 1973; Johnson 1985, 1986, 1987; Johnson and Waldron 1992; Johnston 1981; Johnston and Woodard 1985; Kabzems 1952; Kabzems et al. 1986; Kelsall et al. 1977; Kimmins 1975; Knapik et al. 1988; Lacate et al. 1965; Laidlaw 1974; Landhausser and Lieffers 1994; Langor et al. 1994; La Roi and Ostafichuk 1982; Lee, Crites, Nietfeld, Van Nguyen, and Stelfox 1995; Lee, Crites, and Stelfox 1995; Lee, Crites, Sturgess, and Stelfox 1995; Lewis 1977; Lieffers 1995; Lieffers and Stadt 1994; Lieffers et al. 1993; Macdonald and Lieffers 1991; Maini 1968; Marsden et al. 1996; Messier 1996; Morrall 1964, 1974; Morrall and Vanterpool 1968; Moss 1938, 1953; Navratil and MacIsaac 1996; Parker 1978; Peterson et al. 1988a, b; Peterson and Peterson 1992, 1994; Plylpec and Redmann 1984; Powelson and Lieffers 1991; Rivard et al. 1990; Roberts 1987; Ross et al. 1986; Ross and La Roi 1984; Rowe 1955, 1956b; Rowe and Scotter 1973; Schieck and Nietfeld 1995; Spence et al. 1996; Steneker 1972, 1976; Steneker and Wall 1970; Steneker and Walters 1971; Stringer 1976; Strong 1984, 1992; Strong and La Roi 1983a, b, 1985; Strong and Leggat 1981, 1992; Strong, Navratil, Sidhu, and Thompson 1995; Volney and Cerezke 1992; Wein and El-Bayoumi 1983; Xiao 1987; Yang 1993.

Fire Ecology

Alexander et al. 1983; Apps et al. 1993; Archibold 1979, 1980; Cumming et al. 1995; Delisle and Hall 1987; Dix and Swan 1971; Eberhart 1986; Eberhart and Woodard 1987; Eulert and Hernandez 1980; Flannigan and Van Wagner 1991; Johnson 1987; Johnston 1981; Kelsall et al. 1977; Kurz, Apps, Stocks, and Volney 1995; Lacate et al. 1965; Moss 1953; Rowe 1983; Rowe and Scotter 1973; Steneker

1972; Swan and Dix 1966; Thomas and Wein 1990; Tucker and Jarvis 1967; Wein and MacLean 1983; Yang 1993.

NATURAL-RESOURCE ASSESSMENTS

Climate and Related Effects

Alexander et al. 1983; Apps et al. 1993; Baker et al. 1977; Beak Associates Consulting Ltd. 1987; Beckingham 1990; Bonan et al. 1992; Brown 1989; Brown and Higginbotham 1986; Carder 1972; Cayford et al. 1959; Chesterman and Stelfox 1995; Constabel and Lieffers 1996; Ellis and Clayton 1970; Feng et al. 1989; Flannigan and Van Wagner 1991; Fleming and Volney 1995; Gill 1974; Halliwell et al. 1995; Harris et al. 1983; Hogg 1994; Hogg and Hurdle 1995; Hogg and Lieffers 1991a, c; Howitt 1981; Hunt 1976; Ives 1973, 1981; Jesberger and Sheard 1973; Johnson 1987; Jozsa et al. 1984; Knight 1967; Kojima 1980; Kurz and Apps 1993, 1994, 1995; Kurz, Apps, Beukema, and Lekstrum 1995; Kurz, Apps, Stocks, and Volney 1995; Lakusta 1988; Lieffers 1995; Lieffers and Stadt 1994; MacIver et al. 1972; Marsden et al. 1996; Messier 1996; Miller and Auclair 1974; Murray 1981; Navratil 1995; Parker 1978; Parry, Volney, and Currie 1997; Peterson et al. 1983; Powell and MacIver 1977, 1978; Ross and La Roi 1984; Ross et al. 1986; Shoup et al. 1968; Singh, comp. 1988; Singh and Higginbotham 1988; Singh and Hillman 1972; Singh and Powell 1986; Singh and Wheaton 1991; Steneker 1972; Strong 1992; Strong and Leggat 1981, 1992; Swanson and Hillman 1977b; Telfer 1978; Vaartaja 1960; Van Kooten and Arthur 1988; Volney 1996; Volney and Cerezke 1992; Wheaton et al. 1987; Williams 1985; Wong and English et al. 1989; Zoltai and Strong 1989.

Ecological Land Classification

Achuff 1992; Airphoto Analysis Associates 1979; Alberta Forestry, Lands and Wildlife 1988, 1991b; Anderson 1976, 1980; Archibald 1986; Archibald et al. 1984; Bentz, Brierley, Hay, Nelson, Robertson, and Wehrhahn 1985; Bentz, Johnson, and Brierley 1985; Boyacioglu 1974, 1975; Boyacioglu and Van Waas 1973; Brierley et al. 1985; Brocke 1976; Cameron 1977; Corns 1988, 1989; Crampton 1973; Downing and Bennett 1984; Downing and Legris 1988; Downing et al. 1986,

1987; Duffy 1965; Dutchak 1979, 1982, 1984; Edgar et al. 1986; Hanley 1973; Hardy Associates (1978) Ltd. 1979; Harris et al. 1983; Jarvis et al. 1966; Johnson 1985; Knapik and Westworth 1984; Knapik et al. 1985; Kojima 1980; Kumar 1973a, b, 1975, 1977; Leskiw et al. 1984; MacIsaac 1986; Moss 1955; Nelson 1983; Nelson et al. 1988, 1989; Ojamaa 1977a, b, 1978a, b, c, 1979; O'Leary and Downing 1986a; O'Leary et al. 1986; Park and Bennett 1983; Pennock et al. 1996; Rayner 1984; Reid 1974, 1986; Rowe 1972; Stelfox (H.) 1981; Strong 1978, 1981, 1982, 1988, 1992, 1996a; Strong and Kennedy 1986a, b; Strong and Leggat 1981, 1992; Strong and Thompson 1995; Synergy West Ltd. 1977; Taylor et al. 1989a, b; Thompson et al. 1978; Thorpe 1991; Van Waas 1977a, b, 1978; Van Waas and Boyacioglu 1973; Wiken 1986; Winkler and Rothwell 1983; Zoltai 1969; Zoltai and Strong 1989.

Erosion Assessment

Jaques and Van Eck 1980; Montero 1994; Rothwell 1978; Singh and Kalra 1977.

Hydrology

Beke 1969; C.D. Schultz and Company Ltd. 1973; Johnson 1987; Johnson et al. 1971; Rothwell 1978; Singh and Hillman 1972; Singh and Kalra 1977; Strong 1988; Swanson and Hillman 1977a, b; Swanson and Stevenson 1971; Winkler and Rothwell 1983.

Land Evaluation

Alberta Forestry, Lands and Wildlife 1988, 1991b; Anderson 1980; Anderson and Ellis 1976; Archibald et al. 1996; Ayres et al. 1978; Beckingham and Archibald 1996; Beckingham, Corns, and Archibald 1996; Beckingham, Nielson, and Futoransky 1996; Bentz, Johnson, and Brierley 1985; Boyacioglu 1974, 1975; Boyacioglu and Van Waas 1973; Brierley et al. 1985; Brocke 1976; Cameron 1977; Corns 1989; Corns and Annas 1986; Crampton 1973; Crosson et al. 1970; Downing et al. 1986, 1987; Dumanski et al. 1972; Dutchak 1979, 1982; Edgar et al. 1986; Ellis and Clayton 1970; Hanley 1973; Hardy Associates (1978) Ltd. 1979, 1980; Hay and O'Leary 1988; Head et al. 1981; Holland and Nemeth 1974; Jaques and Van Eck 1980; Kabzems and Senyk 1967; Knapik and Lindsay 1983; Knight 1967; Kumar 1973a, b, 1975, 1977; Luck 1982; Nelson 1983; Ojamaa 1977a, b, 1978a, b, c, 1979; O'Leary 1986; O'Leary and Downing 1986a; Padbury et al. 1978; Peters 1981; Prokopchuk and Archibald 1976; Rostad and Ellis 1972; Saskatchewan Power

Corporation 1977; Scheelar and Macyk 1972; Schultz et al. 1986; Stonehouse and Ellis 1983; Strong 1978, 1981, 1982, 1988; Strong and Kennedy 1986a, b; Synergy West Ltd. 1977; Taylor et al. 1989a, b; Turchenek and Lindsay 1982; Twardy and Corns 1980; Van Waas 1977a, b, 1978; Van Waas and Boyacioglu 1973; Zoladeski et al. 1995.

Physical Land Classification and Geology

Airphoto Analysis Associates 1979; Archibald et al. 1984; Bayrock 1971, 1972a, b, c; Bayrock and Reimchen 1974; Bentz, Brierley, Hay, Nelson, Robertson, and Wehrhahn 1985; Bessie et al. 1986; Bovar Environmental 1996; Boydell et al. 1974; Brierley et al. 1985; Cordes et al. 1975; Ellis and Clayton 1970; Fenton and Andriashek 1983; Ferguson 1980a, b; Hay and O'Leary 1988; Hay et al. 1985; Jaques and Van Eck 1980; Jeffery 1964; Johnson 1985; Kansas et al. 1991; Knapik and Lindsay 1983; Kocaoglu 1975, 1983; Kocaoglu and Bennett 1983; Kocaoglu and Sauchyn 1980; Lacate et al. 1965; Luck 1982; Padbury et al. 1978; Park and Bennett 1983; Peters 1981; Prokopchuk and Archibald 1976; Reid 1974, 1977, 1986; Roed 1970; Strong 1992; Strong and Thompson 1995; Zoltai 1969.

Reclamation

Gower 1989; Green 1980b; Hardy Associates (1978) Ltd. 1979; Laidlaw 1974.

Remote Sensing

Ball and Kolabinski 1979; Franklin et al. 1995; Ghitler et al. 1995a, b; Hall and Aldred 1992; Hall and Klita 1997; Hall et al. 1983, 1984; Thompson et al. 1978.

Soil and Site Conditions

Abouguendia et al. 1986; Addison 1980, 1982; Addison et al. 1984, 1986; Airphoto Analysis Associates 1979; Anderson 1976; Anderson and Ellis 1976; Annas 1977; Annas et al. 1983; Archibald 1986; Archibald et al. 1996; Ayres et al. 1978; Baker 1973; Baker et al. 1977; Beckingham 1990, 1991; Beckingham and Archibald 1996; Beckingham Corns, and Archibald 1996; Beckingham, Nielson, and Futoransky 1996; Beke 1969; Bentz, Brierley, Hay, Nelson, Robertson, and Wehrhahn 1985; Bentz, Johnson, and Brierley 1985; Bessie et al. 1986; Bovar Environmental 1996; Brown 1989; Brown and Higginbotham 1986; Bulmer 1987; Burns and Honkala 1990; Cessna et al. 1989; Corns 1978, 1983, 1989; Corns and Annas 1986; Crosson et al. 1970;

Dix and Swan 1971; Donald et al. 1993; Downing and Bennett 1984; Downing and Karpuk 1992; Downing and Legris 1988; Duffy 1963, 1965; Duffy and Nemeth 1965; Dumanski et al. 1972; Edgar et al. 1986; Ehrentraut and Branter 1990; Ferguson 1980a, b; Giberson 1988; Gorman 1985; Gower 1989; Halliday 1935; Halliwell et al. 1995; Hardy Associates (1978) Ltd. 1980; Harris 1980; Harris et al. 1983; Hay et al. 1985; Hogg and Lieffers 1991; Holland and Nemeth 1974; Holowaychuk and Fessenden 1987; Howitt 1981; Intera Consultants Ltd. 1975; Jameson 1963; Jarvis and Tucker 1968a; Jeffery 1964; Johnson 1985, 1987; Kabzems 1952; Kabzems and Lousier 1992; Kabzems and Senyk 1967; Kabzems et al. 1986; Kansas and Brown 1992; Kansas et al. 1991; Kelsall et al. 1977; Kjeersgaard 1972; Knapik and Lindsay 1983; Knapik et al. 1988; Knight 1967; Knight and Duffy 1967; Kocaoglu 1975, 1983; Kocaoglu and Bennett 1983; Kocaoglu and Sauchyn 1980; Kojima 1980; Kolabinski 1994; Krause et al. 1982; Krumlik et al. 1978, 1982; Lacate et al. 1965; Landhausser et al. 1996; La Roi 1992; Lees 1962a, 1970b; Lehn 1980; Lehn and Higginbotham 1982; Lesko and Lindsay 1973; Lindsay et al. 1957, 1958, 1959, 1960, 1961, 1968; Loman and Associates 1976; Loseth et al. 1990; Macdonald and Lieffers 1993; Macdonald et al. 1996; Marsden et al. 1996; Maynard 1993; Maynard et al. 1994; Montero 1994; Morrall 1964, 1974; Morrall and Vanterpool 1968; Moss 1955; Navratil and Chapman 1991; O'Leary 1986; O'Leary and Downing 1986a, b; O'Leary et al. 1986; Padbury et al. 1978; Park and Bennett 1983; Pennock et al. 1996; Peters 1981; Peters and Bowser 1956; Peterson and Levinsohn 1977; Peterson et al. 1988b; Pluth 1986; Polster and Watson 1979; Prokopchuk and Archibald 1976; Rayner 1984; Reeder and Odynsky 1965, 1969; Reid 1986; Rennie et al. 1985; Roberts 1987; Rostad and Ellis 1972; Rowe 1955, 1956a, b, 1972, 1983; Russell et al. 1984; Santo 1984; Scheelar and Odynsky 1968; Schmidt et al. 1996; Sidhu and Feng 1991, 1993; Stenecker 1973, 1974a, 1976; Stewart and Lieffers 1993, 1994; Stonehouse and Ellis 1983; Strong 1984; Strong and La Roi 1983a, 1985; Swan and Dix 1966; Taylor et al. 1989a, b; Thomas and Wein 1990; Tucker and Jarvis 1967; Turchenek and Lindsay 1982; Twardy 1978; Twardy and Corns 1980; Twardy and Lindsay 1971; Van Groenewoud 1961; Wall et al. 1971; Wright et al. 1992; Wynnyk et al. 1969; Xiao 1987; Yang 1991a, 1993; Zoladeski et al. 1995.

Soil Survey

Airphoto Analysis Associates 1979; Anderson and Ellis 1976; Ayres et al. 1978; Beke 1969; Cordes et al. 1975; Crosson et al. 1970; Dumanski et al. 1972;

Ellis and Clayton 1970; Hardy Associates (1978) Ltd. 1980; Head et al. 1981; Kjeersgaard 1972; Knapik and Lindsay 1983; Kocaoglu 1975; Lindsay et al. 1957, 1958, 1959, 1960, 1961, 1968; Maynard 1990; Maynard and Fairbarns 1994; Peters 1981; Peters and Bowser 1956; Reeder and Odynsky 1965, 1969; Rostad and Ellis 1972; Scheelar and Macyk 1972; Scheelar and Odynsky 1968; Stonehouse and Ellis 1983; Turchenek and Lindsay 1982; Twardy 1978; Twardy and Corns 1980; Twardy and Lindsay 1971; Wynnyk et al. 1969.

Unique Resources

Achuff 1992; Alberta Forestry, Lands and Wildlife 1987a; Argus and Pryer 1990; Crites and Dale 1995; D.A. Westworth and Associates Ltd. 1990; Downing and Legris 1988; Gould 1999; MacIsaac 1986; Maher et al. 1979; Navratil and Chapman 1991; Nelson et al. 1989; Packer and Bradley 1984; Wallis 1987.

Vegetation Assessment

Abouguendia et al. 1986; Abouguendia and Godwin 1980; Addison 1980, 1982, 1984; Addison, Malhotra and Khan 1984; Addison and Puckett 1980; Addison et al. 1984, 1986; Archibald 1981, 1982; Archibald 1979, 1980; Beckingham 1991; Bichlmaier 1985; Bishoff 1981a, b, 1984; Bovar Environmental 1996; Bulmer 1987; Cairns 1976; Case 1977, 1978; Chesterman and Stelfox 1995; Cordes et al. 1975; Corns 1972; Corns and La Roi 1976; Crites and Dale 1995; Cumming et al. 1995; Doerr et al. 1974; Downing and Bennett 1984; Eberhart 1986; Eberhart and Woodard 1987; Elhert and Downing 1994; Ellis 1986; Flanagan and Moser 1985; Franklin et al. 1995; Ghitte et al. 1995a, b; Gill 1974; Hall and Aldred 1992; Hall and Klita 1997; Hall et al. 1983, 1995; Halliday 1935; Halliwell et al. 1995; Hardy Associates (1978) Ltd. 1980; Harris 1980; Horton and Hopkins 1965; IEC Beak Consultants Ltd. 1984; Intera Consultants Ltd. 1975; Jeffery 1964; Jesberger and Sheard 1973; Johnston 1981; Johnston and Woodard 1985; Kansas and Brown 1992; Kansas et al. 1991; Kimmins 1975; Lacate et al. 1965; Landhausser and Lieffers 1994; La Roi and Ellis 1984; La Roi and Ostafichuk 1982; Lee, Crites, Nietfeld, Van Nguyen, and Stelfox 1995; Lee, Crites, and Stelfox 1995; Lee, Crites, Sturgess, and Stelfox 1995; Lesko and Lindsay 1973; Lieffers and Stadt 1994; Loman et al. 1972; Luck 1982; Malhotra and Blauel 1980; Malhotra et al. 1980; Maynard 1990; Maynard and Fairbarns 1994; Maynard et al. 1994; Miller and Auclair 1974; Morrall 1964, 1974; Morrall and Vanterpool 1968;

Moss 1953; Nietfeld 1983; Nowlin 1978; Padbury et al. 1978; Park and Bennett 1983; Peterson et al. 1982, 1983, 1988a; Polster and Watson 1979; Quintilio et al. 1991; Rayner 1984; Reid 1977; Robertson 1994; Ross et al. 1986; Ross and La Roi 1984; Rowe 1956a, b, 1983; Rowe and Scotter 1973; Rusch and Keith 1971; Rusch and Reeder 1978; Russell et al. 1984; Saskatchewan Power Corporation 1977; Schewe and Stewart 1986; Sidhu 1965; Sidhu and Feng 1991; Sidhu et al. 1994; Stelfox (H.) 1981; Stelfox (J.G.) 1988; Stelfox (J.G.) et al. 1976; Strong 1984, 1990; Strong and Kennedy 1986a, b; Strong, Sidhu, and Navratil 1995; Swan and Dix 1966; Swanson and Stevenson 1971; Syncrude Canada Ltd. 1973; Telfer 1974; Telfer and Cairns 1978; Telfer and Scotter 1969; Thorpe 1978; Trottier 1980; Usher 1978, 1981; Van Camp and Telfer 1975a; Wall et al. 1971; Wehrhahn 1981, 1982; Winkler and Rothwell 1983; Wollis 1991.

Vegetation Classification

Airphoto Analysis Associates 1979; Anderson 1980; Annas 1977; Annas et al. 1983; Archibald 1981, 1982, 1986; Archibald et al. 1984, 1996; Beckingham and Archibald 1996; Beckingham, Corns, and Archibald 1996; Beckingham, Nielson, and Futoransky 1996; Bentz, Brierley, Hay, Nelson, Robertson, and Wehrhahn 1985; Bishoff 1981a, b, 1984; Brierley et al. 1985; Case 1978; Cordes et al. 1975; Corns 1978, 1983; Corns and Annas 1986; Dix and Swan 1971; Downing and Karpuk 1992; Downing and Legris 1988; Downing et al. 1986; Hardy Associates (1978) Ltd. 1979; Hay et al. 1985; Jaques and Van Eck 1980; Kabzems et al. 1986; Knapik et al. 1988; Kocaoglu and Bennett 1983; Kojima 1980; Krumlik et al. 1978, 1982; La Roi 1992; La Roi and Ellis 1984; Lee, Crites, Sturgess, and Stelfox 1995; Luck 1982; MacIsaac 1986; Moss 1955; Nelson 1983; Nelson et al. 1988, 1989; O'Leary and Downing 1986b; O'Leary et al. 1986; Padbury 1978; Peterson and Levinsohn 1977; Polster and Watson 1979; Reid 1974, 1977, 1986; Rowe 1956b; Russell 1986; Stringer 1976; Strong et al. 1990; Sunquist et al. 1997; Wehrhahn 1981, 1982; Willoughby et al. 1996; Zoladeski et al. 1995.

RESOURCE-DEVELOPMENT EFFECTS

Environmental Impacts

Alberta Environmental Centre 1981; Bella 1986b; Bovar Environmental 1996; Crampton 1995; Fisher 1982; Green 1980b; Hardy Associates (1978) Ltd. 1981; Jaques and Van Eck 1980; La Roi and Ellis 1984; Leskiw et al. 1984; Maynard 1990; Padbury

1986; Penner et al. 1980; Regier 1985; Rothwell 1978; Saskatchewan Power Corporation 1977; Thompson et al. 1980; Willoughby 1995.

Fire Management and Effects

Alexander et al. 1983; Chrosiewicz 1988; Delisle and Hall 1987; Ferguson (T.) 1980; Horton and Hopkins 1965; Jarvis and Tucker 1968a, b; Johnson 1987; Johnson et al. 1971; Johnston and Woodard 1985; Kiil 1970; Kurz and Apps 1995; Laird 1987; Lees 1962a; Lewis 1977; Lieffers et al. 1993; Phillips et al. 1986; Ponto 1990; Quintilio et al. 1991; Rowe 1955; Shoup et al. 1968; Singh 1988; Stelfox (J.B.) et al. 1991; Thomas and Wein 1990; Tucker and Jarvis 1967; Vega Garcia 1994; Wein and MacLean 1983.

Forest Grazing

Archibald 1981, 1982; Archibald et al. 1984; Beckingham 1990, 1991; Bichlmaier 1985; Bishoff 1981a, b, 1984; Downing and Karpuk 1992; Elhert and Downing 1994; Hay et al. 1985; Hilton and Bailey 1974; Hudson 1975; Kocaoglu and Bennett 1983; Ojamaa 1977a, b, 1978c, 1979; O'Leary and Downing 1986a; Pringle et al. 1973; Sidhu 1965; Strong 1990; Sunquist et al. 1997; Telfer and Scotter 1969; Thorpe 1978; Waddington and Bittman 1987; Weatherill and Keith 1969; Wehrhahn 1981, 1982; Wheeler and Willoughby 1993; Willoughby 1995; Willoughby et al. 1996.

Forest-harvesting Effects

Anderson 1976; Apps et al. 1993; Ball and Walker 1995; Bella 1972, 1986a; Bella and De Franceschi 1972; Bella and Gál 1996; Bella and Jarvis 1967; Bonan et al. 1992; Boyd 1978; Brace 1990, 1991; Brace Forest Services 1992; Brace and Bella 1988; C.D. Schultz and Company Ltd. 1973; Corns 1972; Corns and La Roi 1976; Cotterill 1996; Cumming et al. 1995; Dancik et al. 1990; D.A. Westworth and Associates Ltd. 1981; Froning 1980; Grewal 1988, 1995; Gullion 1986; Henderson 1987; Hogg and Lieffers 1991a, b; Hunt 1976; Jarvis et al. 1966; Johnson 1985, 1987; Johnson and Waldron 1992; Johnson et al. 1971; Jones 1978; Kiil 1970; Kurz and Apps 1995; Landhauser and Lieffers 1997; Lees 1962a, b, 1970a, b; Lieffers 1995; Lieffers, Macmillan, MacPherson, Branter, and Stewart 1996; Macdonald and Lieffers 1991; Machtan 1996; Messier 1996; Navratil 1995; Navratil and Bella 1989; Navratil et al. 1994; Penner 1990; Penner and Associates Ltd. 1991; Peterson and Peterson 1994; Peterson et al. 1983; Robertson 1994; Rothwell 1978;

Sauder 1992; Schewe and Stewart 1986; Schmidt et al. 1996; Schneider 1988; Shoup 1970; Shoup et al. 1968; Singh and Hillman 1972; Singh and Kalra 1977; Smith and Crook 1996; Spence and Langor 1994; Spence et al. 1996; Stelfox (J.B.) et al. 1991; Stelfox (J.G.) 1981, 1984, 1988; Stelfox (J.G.) et al. 1973, 1976; Swanson and Hillman 1977a, b; Telfer 1974; Tonn 1978; Tonn et al. 1981; Urban et al. 1994; Usher 1978, 1981; Weaver 1996; Weldwood of Canada Limited 1990; Westworth et al. 1984; Wollis 1991.

Pollution Effects

Abouguendia and Godwin 1980; Abouguendia et al. 1986; Addison 1980, 1982, 1984; Addison, Malhotra, and Khan 1984; Addison and Puckett 1980; Addison et al. 1984, 1986; Apps et al. 1993; Baker et al. 1977; Bonan et al. 1992; Brown 1989; Brown and Higginbotham 1986; Case 1978; Feng and Navratil 1990; Garden and Davies 1988; Gower 1989; Halliwell et al. 1995; Hardy Associates (1978) Ltd. 1979; Hogg and Hurdle 1995; Holowaychuk and Fessenden 1987; Intera Consultants Ltd. 1975; Kurz and Apps 1993, 1994, 1995; Kurz, Apps, Beukema, and Lekstrum 1995; Kurz, Apps, Stocks, and Volney 1995; L'Hirondelle et al. 1986; Liefers and Campbell 1984; Loman et al. 1972; Loman and Associates 1976; Malhotra and Blauel 1980; Malhotra et al. 1980; Maynard 1990; Maynard and Fairbairns 1994; Maynard et al. 1994; Murray 1981; Navratil, Bella, and Peterson 1990; Navratil and Chapman 1991; Padbury 1986; Parker 1978; Plylpec and Redmann 1984; Sidhu and Feng 1991, 1993; Sidhu et al. 1994; Singh and Higginbotham 1988; Singh and Wheaton 1991; Volney 1996; Xiao 1987.

SILVICULTURE

Competition Analysis

Bella 1969; Brown and Navratil 1995; MacIsaac 1995; MacIsaac and Navratil 1996; Navratil and MacIsaac 1993, 1996; Navratil, Phillips, and Morton 1990; Steneker 1974b; Steneker and Jarvis 1963; Strong, Navratil, Sidhu, and Thompson 1995; White 1981.

Even-aged Stand Management

Bella 1968; Cayford 1957; Johnson 1985; Lees 1960; Liefers, Macmillan, MacPherson, Branter, and Stewart 1996; Peterson (N.) 1990; Pielou et al. 1986; Shoup et al. 1968; Yang 1993.

Forest-damage Agents

Basham 1987; Blenis et al. 1995; Brandt 1994a, b; Burns and Honkala 1990; Caltrell and Amirault 1991; Campbell et al. 1969; Cayford et al. 1959; Cerezke 1991a, b, c, 1992, 1994a, b; Digweed 1995; Drouin and Kusch 1975, 1976, 1977, 1979, 1980; Drouin and Langor 1991, 1992; Drouin and Wong 1975; Drouin et al. 1991; Fleming and Volney 1995; Gill 1974; Hall et al. 1983, 1984, 1995; Henderson 1987; Hildahl and Campbell 1975; Hildahl and Hiratsuka 1991; Hildahl and Reeks 1960; Hiratsuka 1987, 1994; Hiratsuka and Loman 1984; Hiratsuka and Maruyama 1991; Hiratsuka et al. 1990; Hiratsuka et al. 1995; Ip 1992; Ives 1973, 1981; Ives and Muldrew 1978; Ives and Wong 1988; Ives et al. 1982; Jarvis 1968; Johnson 1985; Johnson and Waldron 1992; Johnson et al. 1971; Kirby 1962; Kirby et al. 1957; Kolabinski 1969a, c; Kurz, Apps, Stocks, and Volney 1995; Kusch and Cerezke 1991a, b; Kusch and Langor 1992; Langor 1995; Langor et al. 1992; Maier and Darrah 1989; Mallett 1990, 1992, 1994; Mallett and Volney 1990; Maruyama 1991; Maruyama and Hiratsuka 1991; McLaughlin and Dumas 1996; Myrholm and Cerezke 1994; Parry, Volney, and Currie 1997; Paul and Etheridge 1958; Peterson and Peterson 1992; Peterson (N.) 1990; Raske 1974; Shoup et al. 1968; Smith 1978; Smith and Crook 1996; Steneker 1976; Steneker and Wall 1972; Thomas et al. 1960; Tidsbury et al. 1992; Volney 1988a, b, 1989, 1994, 1995, 1996; Volney and Cerezke 1992; Wall 1969, 1971; Wong and Melvin 1974, 1976; Wong et al. 1977; Wong et al. 1991; Yang 1993; Zalasky 1968, 1975; Zalasky and Hiratsuka 1992.

Forest Policy

Alberta Energy and Natural Resources 1984a; Alberta Environmental Protection 1993, 1996a; Dancik et al. 1990; Denney 1988; Fisher 1982; Henderson 1987; Jackson 1974; MacDonald 1996; McDonald 1979; Murphy 1988; Penner and Associates Ltd. 1991; Rannard 1974; Young 1974.

Genetics and Cellular Structure

Basham 1987; Cheliak 1980; Cheliak and Dancik 1982; Cormack 1965; Cormack and Lemay 1966; Hansen 1995; Heidt 1983; Jaquish 1981; Kimmins 1975; Lehn 1980; Lehn and Higginbotham 1982; Peterson (N.) 1990; Smith and Crook 1996; Steneker 1973; Steneker and Wall 1970; Swan and Kellogg 1986; Wall 1971; Yanchuk et al. 1987, 1988.

Growth and Yield

Bella 1968, 1969, 1970, 1975, 1986a, b; Bella and De Franceschi 1972, 1980a, b; Bella and Gál 1996; Bella and Jarvis 1967; Blenis et al. 1995; Brown and Navratil 1995; Burns and Honkala 1990; Campbell et al. 1985; Cayford et al. 1959; Cieszewski and Bella 1991; De Franceschi 1969; Duffy 1965; Gál and Bella 1994; Grabowski et al. 1981; Grewal 1995; Huang 1994a, b, c, d, e, f, g, 1996; Huang, Lakusta, and Giacobbo 1994; Huang, Lakusta, and Held 1994; Huang and Titus 1995, 1996; Huang, Titus, and Lakusta 1994; Huang, Titus, Lakusta, and Held 1994; Jarvis 1968; Jarvis et al. 1966; Johnson 1957, 1985, 1986, 1987; Johnstone and Peterson 1980; Kabzems 1952, 1971; Kagiš 1952; Kirby 1962; Kirby et al. 1957; Krause et al. 1982; Krumlik et al. 1978, 1982; Lacate et al. 1965; Lees 1966; Lehn 1979; Lehn and Higginbotham 1982; Lesko and Lindsay 1973; Liefers, Stadt, and Navratil 1996; Loseth et al. 1990; MacLeod and Blyth 1955; Navratil 1996a; Navratil, Bella, and Peterson 1990; Navratil and Chapman 1991; O'Leary and Downing 1986b; Peterson 1970; Peterson (N.) 1990; Peterson and Levinsohn 1977; Peterson and Peterson 1992; Peterson et al. 1982, 1983, 1988b; Phillips et al. 1986; Pielou et al. 1986; Pike 1953; Prokopchuk and Archibald 1976; Quaite 1953; Shoup et al. 1968; Singh 1982a, b, 1983, 1984a, b, 1986, 1987, 1988; Stelter 1985; Steneker 1963, 1964, 1966, 1967, 1969a, 1973, 1974b, c; Steneker and Jarvis 1966; Volney 1988b; Weetman 1983; White 1981; Yang 1989, 1991a, b, 1993; Yang and Bella 1994; Young 1979, 1980.

Juvenile Stand-tending

Bella 1975; Cayford 1957; De Franceschi and Bell 1990; Grewal 1988; Holmsen 1988; Jarvis et al. 1966; Johnson 1985, 1986; Kabzems and Lousier 1992; Kolabinski 1969a, b, c; Navratil and Bella 1989; Navratil and Chapman 1991; Navratil et al. 1996; Pike 1953; Shoup et al. 1968; Steneker 1963, 1964, 1966, 1967, 1969a, 1974c, 1976; Steneker and Jarvis 1966; Steneker and Wall 1972; Strong 1996b; White 1981; Yang 1989, 1991b.

Pest Control

Brandt 1994a, b; Caltrell and Amirault 1991; Campbell et al. 1969; Cerezke 1991a, b, c, 1992, 1994a; Digweed 1995; Drouin and Kusch 1975, 1976, 1977, 1979, 1980; Drouin and Langor 1991, 1992; Drouin and Wong 1975; Drouin et al. 1991; Fleming and Volney 1995; Garden and Davies 1988; Hildahl and Campbell 1975; Hildahl and Hiratsuka 1991; Hiratsuka 1994; Hiratsuka and Maruyama 1991; Ip 1992; Ives 1973; Ives and Muldrew 1978; Ives et al.

1982; Kusch and Cerezke 1991a, b; Kusch and Langor 1992; Langor 1995; Langor et al. 1992; Mallett 1994; Maruyama 1991; Maruyama and Hiratsuka 1991; Myrholm and Cerezke 1994; Parry 1994, 1995; Parry, Spence, and Volney 1997; Tidsbury et al. 1992; Volney 1988a, 1994, 1995; Wong et al. 1991; Zalasky and Hiratsuka 1992.

Plant Propagation

Cormack 1965; Cormack and Lemay 1966; Laidlaw 1974; Moss 1938; Peterson (N.) 1990; Steneker 1972, 1974a; Steneker and Prasad 1972; Steneker and Walters 1971; Stewart and Liefers 1993.

Reforestation

Ball and Kolabinski 1979, 1986; Ball and Walker 1995; Chrosciewicz 1988; Constabel and Liefers 1996; Dancik et al. 1990; Delong 1995; Doucet 1989; Duffy 1963; Dyck 1994; Grewal 1995; Hall and Aldred 1992; Hansen 1995; Johnson 1985; Johnson and Gorman 1977; Johnson et al. 1971; Kabzems and Lousier 1992; Kolabinski 1969c, 1994; Laidlaw 1974; Lakusta 1988; Leblanc and Sutherland 1987; Lees 1962b, 1963, 1964, 1965, 1970b; Liefers, Stadt, and Navratil 1996; Macdonald et al. 1996; Marsden et al. 1996; Montero 1994; Peterson and Peterson 1994; Schneider 1988; Shoup 1970; Steneker and Walters 1971; Tanner et al. 1996; Urban et al. 1994; Wheeler and Willoughby 1993.

Silviculture

Delong 1995; Doucet 1989; Gorman 1985; Jarvis 1968; Johnson 1985; Johnson and Gorman 1977; Lees 1960, 1962a; Liefers, Macmillan, MacPherson, Branter, and Stewart 1996; MacDonald 1996; Navratil 1996c; Navratil, Bella, and Peterson 1990.

Site Preparation

Ball 1990; Ball and Walker 1995; Brown and Navratil 1995; Chrosciewicz 1988; Corns and Annas 1986; Corns and La Roi 1976; Delong 1995; Duffy and Nemeth 1967; Dyck 1994; Gibbard and Sutherland 1987; Gorman 1985; Hogg and Liefers 1991a, b; Jarvis et al. 1966; Jarvis and Tucker 1968a, b; Johnson 1985, 1987; Johnson and Gorman 1977; Johnson and Waldron 1992; Kolabinski 1965, 1969a, b, c, 1994; Landhausser and Liefers 1994; Leblanc and Sutherland 1987; Lees 1963, 1965, 1970a, b; Macdonald et al. 1996; Montero 1994; Navratil 1995; Navratil and Bella 1989; Navratil et al. 1996; Penner and Associates Ltd. 1991; Peterson (N.) 1990; Pluth 1986; Rivard et al. 1990; Schmidt et al. 1996; Shoup

1970; Shoup et al. 1968; Sidhu and Feng 1991; Smith and Crook 1996; Smither 1959; Stelfox (J.G.) 1981, 1984; Stelfox (J.G.) et al. 1976; Steneker 1969b; Strong, Navratil, Sidhu, and Thompson 1995; Strong, Sidhu, and Navratil 1995; Thomas and Wein 1990; Waldron 1964; Waldron and Kolabinski 1994.

Soil and Site Productivity

Anderson 1976; Annas et al. 1983; Archibald 1986; Corns 1978, 1988, 1989; Donald et al. 1993; Duffy 1965; Jameson 1963; Knapik et al. 1988; Knight 1967; Knight and Duffy 1967; Krause et al. 1982; Lesko and Lindsay 1973; Peterson and Levinsohn 1977; Peterson and Peterson 1992; Prokopchuk and Archibald 1976; Rivard et al. 1990; Rowe 1956b; Scheelar and Macyk 1972; Yang 1991a.

Tree-crop Production

Ball and Kolabinski 1986; Bella 1970; Bella and De Franceschi 1980a; Bella and Hunt 1973; Bentz, Johnson, and Brierley 1985; Bonnor 1982; Campbell and Dunfield 1969; Corns 1972, 1978, 1983, 1988; Corns and Annas 1986; Grant 1980; Grewal 1988; Head et al. 1981; Heidt 1983; Jarvis 1968; Johnson 1957, 1985; Jozsa et al. 1984; Kabzems 1952; Kabzems and Senyk 1967; Lees 1964; Lehn 1979; Lieffers and Campbell 1984; Miller 1974; Navratil and Bella 1989; Navratil and Chapman 1991; Peterson et al. 1982, 1988a; Singh 1982a, b, 1983, 1984a, b, 1986, 1987; Smith 1989; Strong 1984; Tanner et al. 1996; Williams 1985; Young 1974.

Understory Protection

Brace 1990, 1991; Brace Forest Services 1992; Brace and Bella 1988; Froning 1980; Navratil and Chapman 1991; Navratil 1996a, c; Navratil et al. 1994; Sauder 1992.

Uneven-aged Stand Management

Bella and Gál 1996; Brace Forest Services 1992; De Franceschi and Bell 1990; Delong 1995; Duffy 1963; Duffy and Nemeth 1965, 1967; Jameson 1963; Johnson 1985, 1986; Kagi 1952; Kolabinski 1969c; Lees 1960, 1962b, 1963, 1964, 1966, 1970a; Lieffers, Macmillan, MacPherson, Branter, and Stewart 1996; Lieffers, Stadt, and Navratil 1996; Navratil 1996a; Peterson (N.) 1990; Pike 1953; Shoup 1970; Shoup et al. 1968; Steneker 1963, 1964, 1967, 1974b; Tanner et al. 1996; Urban et al. 1994; Waldron and Kolabinski 1994; Yang 1989, 1991b; Yang and Bella 1994.

Vegetation Control—*Calamagrostis*

Hogg and Lieffers 1991a, b, c; Kabzems and Lousier 1992; Landhausser and Lieffers 1994; Landhausser et al. 1996; Lieffers et al. 1993; Lieffers and Stadt 1994; Macdonald and Lieffers 1991, 1993; Powelson and Lieffers 1991; Rivard et al. 1990.

Vegetation Control—Chemical

Ball and Walker 1995; Cessna et al. 1989; Corns and Dai 1967; Dai 1966; Drouin 1989; Dyck 1994; Feng et al. 1989; Feng and Navratil 1990; Hilton and Bailey 1974; Johnson 1986; Kimmins 1975; Kimmins and Fraker 1973; Laird 1987; Lees 1966; Lieffers et al. 1993; MacDonald 1996; Malik and Vanden Born 1986; Maynard 1993; Navratil and Lane 1987; Navratil et al. 1996; Penner 1990; Peterson (N.) 1990; Pratt 1966; Quate 1953; Rennie et al. 1985; Sidhu and Feng 1991, 1993; Sidhu et al. 1994; Steneker 1976; Strong, Navratil, Sidhu, and Thompson 1995; Strong, Sidhu, and Navratil 1995; Waddington and Bittman 1987.

Vegetation Control—Mechanical

Ball 1990; Bella 1972; Brown and Navratil 1995; De Franceschi and Bell 1990; Ehrentraut and Branter 1990; Gibbard and Sutherland 1987; Holmsen 1988; Johnson 1986; Johnson and Waldron 1992; Kolabinski 1965; Laird 1987; Landhausser and Lieffers 1997; Leblanc and Sutherland 1987; Lees 1965; Lieffers et al. 1993; Navratil and Lane 1987; Navratil et al. 1996; Peterson (N.) 1990; Pike 1953; Pringle et al. 1973; Sidhu and Feng 1991; Sidhu et al. 1994; Smither 1959; Steneker 1963, 1964, 1966, 1967, 1969b; Strong 1996b; Strong, Navratil, Sidhu, and Thompson 1995; Strong, Sidhu, and Navratil 1995; Yang and Bella 1994.

SUSTAINABLE BENEFITS

Economics—Fiber

Alberta Environmental Protection 1993, 1996a; Bella and Hunt 1973; Bella and Jarvis 1967; Bonnor 1982; Brace and Bella 1988; Brace Forest Services 1992; Campbell and Dunfield 1969; C.D. Schultz and Company Ltd. 1973; Fregren 1980; Grant 1980; Hardy Associates (1978) Ltd. 1981; Hogg and Hurdle 1995; Howlett 1989; Jackson 1974; Johnson 1985, 1986, 1987; Kabzems 1971; Kabzems and Senyk 1967; Kabzems et al. 1986; Kirby 1962; Kirby et al. 1957; MacDonald 1996; Maier and Darrah 1989; Manning and Grinnell 1971; McDonald 1979; Miller 1974; Navratil 1996b; Paul and Etheridge 1958; Phillips et al. 1986; Rannard 1974; Schneider

1988; Shoup et al. 1968; Singh 1984b; Smith 1989; Swan and Kellogg 1986; Thomas et al. 1960; Van Kooten and Arthur 1988; Weetman 1983; Yanchuk et al. 1987, 1988; Yang 1993; Yang and Bella 1994; Young 1974.

Economics—Nonfiber

Achuff 1992; Alberta Energy and Natural Resources 1984b; Alberta Environmental Protection 1993, 1996a; Brace Forest Services 1992; C.D. Schultz and Company Ltd. 1973; Fillion et al. 1983; MacDonald 1996; Navratil 1996b; Navratil and Chapman 1991; Phillips et al. 1986.

Recreation

Alberta Environmental Protection 1993, 1996a; Fillion et al. 1983; Schultz et al. 1986; Vega Garcia 1994.

Resource Planning

Alberta Energy and Natural Resources 1984a, 1985a, b, c, d; Alberta Environmental Protection 1993, 1996a, b; Alberta Forestry, Lands and Wildlife 1986a, b, c, 1987a, b, c, d, 1990, 1991a; Dancik et al. 1990; Denney 1988; Fisher 1982; Phillips et al. 1986.

TREE SPECIES

Aspen

Abouguendia et al. 1986; Addison, Malhotra, and Khan 1984; Ball 1990; Basham 1987; Bella 1968, 1969, 1970, 1972, 1975, 1986a; Bella and De Franceschi 1972, 1980a, b; Bella and Hunt 1973; Bella and Jarvis 1967; Blenis et al. 1995; Brace 1990, 1991; Brown 1989; Brown and Higginbotham 1986; Buimer 1987; Burns and Honkala 1990; Campbell and Dunfield 1969; Campbell et al. 1969; Campbell et al. 1985; Case 1977; Cayford 1957; Cayford et al. 1959; Cerezke 1992; Cessna et al. 1989; Cheliak 1980; Cheliak and Dancik 1982; Chesterman and Stelfox 1995; Chrosciewicz 1988; Cieszewski and Bella 1991; Corns 1972, 1989; Corns and Dai 1967; Corns and La Roi 1976; Crampton and Barclay 1995; Crites and Dale 1995; Dai 1966; D.A. Westworth and Associates Ltd. 1981; De Franceschi 1969; De Franceschi and Bell 1990; Doerr et al. 1974; Doucet 1989; Drouin and Kusch 1977; Drouin and Langor 1992; Duffy 1963; Duffy and Nemeth 1965, 1967; Elhert and Downing 1994; Eulert and Hernandez 1980; Feng et al. 1989; Franklin et al. 1995; Fregren 1980; Froning 1980; Gál and Bella 1994; Ghitter et al. 1995a, b; Grabowski et al. 1981; Grant 1980; Grewal

1988, 1995; Gullion 1986; Hall and Aldred 1992; Hall and Klita 1997; Hall et al. 1983, 1984; Heidt 1983; Henderson 1987; Hildahl and Campbell 1975; Hildahl and Reeks 1960; Hilton and Bailey 1974; Hiratsuka 1987; Hiratsuka and Loman 1984; Hiratsuka et al. 1990; Hiratsuka et al. 1995; Hogg and Hurdle 1995; Holmsen 1988; Horton and Hopkins 1965; Huang 1994g; Huang and Titus 1996; Huang, Titus, Lakusta, and Held 1994; Ives 1973; Jackson 1974; Jaquish 1981; Jarvis 1968; Jarvis and Tucker 1968b; Jarvis et al. 1966; Johnson 1985, 1986, 1987; Johnstone and Peterson 1980; Kabzems and Lousier 1992; Kagi 1952; Kirby et al. 1957; Kolabinski 1969a, b, c; Laidlaw 1974; Lee, Crites, Nietfeld, Van Nguyen, and Stelfox 1995; Lee, Crites, and Stelfox 1995; Lee, Crites, Sturgess, and Stelfox 1995; Lehn 1979, 1980; Lehn and Higginbotham 1982; L'Hirondelle et al. 1986; Lieffers and Campbell 1984; Loeth et al. 1990; MacIsaac and Navratil 1996; MacLeod and Blyth 1955; Maier and Darrah 1989; Maini 1968; Mallett 1992; Maynard et al. 1994; McDonald 1979, 1995; McLaughlin and Dumas 1996; Miller 1974; Moss 1938; Navratil 1996b, c; Navratil and Bella 1989; Navratil, Bella, and Peterson 1990; Navratil and Chapman 1991; Navratil and Lane 1987; Navratil and MacIsaac 1993, 1996; Navratil, Phillips, and Morton 1990; Navratil et al. 1994; Parker 1978; Parry, Volney, and Currie 1997; Paul and Etheridge 1958; Peterson (N.) 1990; Peterson and Peterson 1992; Peterson et al. 1982, 1983, 1988a, b; Pielou et al. 1986; Pike 1953; Pylpec and Redmann 1984; Pratt 1966; Pringle et al. 1973; Quate 1953; Quintilio et al. 1991; Rannard 1974; Regier 1985; Rowe 1956a; Roy et al. 1995; Rusch and Keith 1971; Rusch and Reeder 1978; Schieck and Nietfeld 1995; Schieck and Roy 1995; Schneider 1988; Shoup 1970; Shoup et al. 1968; Sidhu and Feng 1991; Singh 1982a, b, 1983, 1984a, b, 1986, 1987; Smither 1959; Stelfox (J.B.) et al. 1995; Stelter 1985; Stenecker 1963, 1964, 1966, 1967, 1969a, 1972, 1973, 1974a, c, 1976; Stenecker and Jarvis 1963, 1966; Stenecker and Prasad 1972; Stenecker and Wall 1970, 1972; Stenecker and Walters 1971; Strong 1984, 1996b; Strong and La Roi 1983a, b; Strong, Navratil, Sidhu, and Thompson 1995; Strong, Sidhu, and Navratil 1995; Thomas et al. 1960; Timmermann and McNicol 1988; Tucker and Jarvis 1967; Vaartaja 1960; Volney 1988b, 1995; Waldron 1964; Waldron and Kolabinski 1994; Wall 1969, 1971; Wall et al. 1971; Weetman 1983; Wheeler and Willoughby 1993; Willoughby 1995; Wong and Melvin 1974, 1976; Wong et al. 1977; Yanchuk et al. 1987, 1988; Yang 1989, 1991a, b, 1993; Yang and Bella 1994; Young 1974, 1979; Zalasky 1968; Zalasky and Hiratsuka 1992.

Balsam Fir

Burns and Honkala 1990; Cerezke 1991c; Eulert and Hernandez 1980; Gál and Bella 1994; Huang 1994d, g; Huang, Lakusta, and Held 1994; Huang, Titus, Lakusta, and Held 1994; Mallett 1992; Singh 1982a, b, 1984b, 1986, 1987; Strong and La Roi 1983b; Weetman 1983; Young 1979.

Balsam Poplar

Burns and Honkala 1990; Campbell and Dunfield 1969; Campbell et al. 1969; Cormack 1965; Cormack and Lemay 1966; Corns and Dai 1967; Cerezke 1991b, 1992; Dai 1966; Drouin and Wong 1975; Eulert and Hernandez 1980; Gál and Bella 1994; Garden and Davies 1988; Grant 1980; Green 1980a; Hildahl and Campbell 1975; Hiratsuka 1987; Hiratsuka and Loman 1984; Hiratsuka et al. 1995; Huang 1994g; Huang, Lakusta, and Giacobbo 1994; Huang, Titus, Lakusta, and Held 1994; Jarvis 1968; Johnstone and Peterson 1980; Maini 1968; McDonald 1979; Miller 1974; Navratil and Chapman 1991; Navratil et al. 1994; Paul and Etheridge 1958; Peterson (N.) 1990; Peterson and Peterson 1992; Peterson et al. 1983; Pratt 1966; Rannard 1974; Singh 1982a, b, 1983, 1984a, b, 1986, 1987; Swan and Kellogg 1986; Thomas et al. 1960; Volney 1995; Wong et al. 1977; Young 1974, 1980; Zalasky 1975; Zalasky and Hiratsuka 1992.

Black Spruce

Addison and Puckett 1980; Addison, Malhotra, and Khan 1984; Burns and Honkala 1990; Cieszewski and Bella 1991; Eulert and Hernandez 1980; Fuller and Keith 1980b, 1981; Gál and Bella 1994; Hiratsuka 1987, 1994; Hiratsuka et al. 1995; Huang 1994b, d, g; Huang, Titus, Lakusta, and Held 1994; Johnson 1985, 1987; Loseth et al. 1990; MacIsaac 1995; MacIsaac and Navratil 1996; Malhotra et al. 1980; Parker 1978; Peterson and Peterson 1994; Plylpec and Redmann 1984; Rannard 1974; Rusch and Reeder 1978; Singh 1982a, b, 1983, 1984a, b, 1986, 1987; Strong 1984; Strong and La Roi 1983a, b; Weetman 1983; Wong et al. 1977.

Jack Pine

Addison, Malhotra, and Khan 1984; Addison et al. 1986; Ball and Kolabinski 1986; Bella 1969; Burns and Honkala 1990; Cerezke 1994b; Chrosiewicz 1988; Eulert and Hernandez 1980; Hall and Aldred 1992; Hall et al. 1995; Hiratsuka 1987; Hiratsuka and Maruyama 1991; Hogg 1994; Huang 1994d, f, g; Huang, Titus, Lakusta, and Held 1994; Johnson 1985; L'Hirondelle et al. 1986; Loseth et al. 1990;

MacIsaac 1995; MacIsaac and Navratil 1996; Malhotra et al. 1980; Mallett 1992; Mallett and Volney 1990; Parker 1978; Peterson et al. 1983; Plylpec and Redmann 1984; Rannard 1974; Rusch and Reeder 1978; Singh 1982a, b, 1983, 1984a, b, 1986, 1987; Strong 1984; Strong and La Roi 1983a, b; Thomas and Wein 1990; Volney 1988a, 1994; Weetman 1983; Wong et al. 1977; Wright et al. 1992; Young 1979.

Lodgepole Pine

Addison et al. 1984; Brown and Navratil 1995; Burns and Honkala 1990; Cerezke 1994b; Cieszewski and Bella 1991; Corns 1972; Corns and La Roi 1976; Gál and Bella 1994; Hiratsuka 1987; Hiratsuka and Maruyama 1991; Hogg 1994; Huang 1994c, d, g, 1996; Huang, Titus, Lakusta, and Held 1994; Johnson 1987; Mallett 1992; Maynard 1990; Maynard et al. 1994; MacIsaac and Navratil 1996; Navratil and MacIsaac 1993; Navratil, Phillips, and Morton 1990; Prokopchuk and Archibald 1976; Singh 1982a, b, 1984b; Stewart and Lieffers 1993, 1994; Strong, Sidhu, and Navratil 1995; Young 1979.

White Birch

Addison, Malhotra, and Khan 1984; Burns and Honkala 1990; Cerezke 1991b, 1992, 1994a; Digweed 1995; Eulert and Hernandez 1980; Gál and Bella 1994; Giberson 1988; Huang 1994f; Mallett 1992; Peterson et al. 1983; Pratt 1966; Singh 1982a, b, 1984b, 1986, 1987; Weetman 1983; Wong et al. 1977; Wong et al. 1991; Young 1980.

White Spruce

Abouguendia et al. 1986; Addison, Malhotra, and Khan 1984; Ball 1990; Ball and Kolabinski 1979, 1986; Ball and Walker 1995; Bella and Gál 1996; Blenis et al. 1995; Brace 1990, 1991; Brace Forest Services 1992; Brown 1989; Brown and Higginbotham 1986; Brown and Navratil 1995; Burns and Honkala 1990; Caltrell and Amirault 1991; Cayford 1957; Cerezke 1991c, 1994b; Chrosiewicz 1988; Cieszewski and Bella 1991; De Franceschi and Bell 1990; Delong 1995; Duffy 1963; Duffy and Nemeth 1965, 1967; Dyck 1994; Eulert and Hernandez 1980; Franklin et al. 1995; Gál and Bella 1994; Ghitter et al. 1995a, b; Hall and Klita 1997; Hansen 1995; Hiratsuka 1987, 1994; Hiratsuka et al. 1995; Hogg 1994; Holmsen 1988; Huang 1994d, e, g; Huang and Titus 1995, 1996; Huang, Titus, Lakusta, and Held 1994; Jarvis and Tucker 1968b; Jarvis et al. 1966; Johnson 1985, 1986, 1987; Johnson and Gorman 1977; Jozsa et al. 1984; Kabzems 1971;

Kabzems and Lousier 1992; Kagis 1952; Kirby 1962; Kolabinski 1965, 1969a, b, c, 1994; Kusch and Cerezke 1991b; Lacate et al. 1965; Lees 1962b, 1963, 1966, 1970a; Lieffers and Stadt 1994; Loseth et al. 1990; Macdonald et al. 1996; MacIsaac 1995; Malhotra et al. 1980; Mallett 1992; Navratil 1996a, b, c; Navratil and MacIsaac 1996; Navratil et al. 1994; Peterson and Peterson 1994; Peterson et al. 1983; Pike 1953; Plylpec and Redmann 1984; Prokopchuk and Archibald 1976; Quaitie 1953; Rannard 1974; Rivard et al. 1990; Rowe 1955, 1956a; Sauder 1992; Singh 1982a, b, 1983, 1984a, b, 1986, 1987; Smither 1959; Stelter 1985; Steneker 1963, 1964, 1966, 1967, 1969b, 1974b; Steneker and Jarvis 1963; Strong 1984; Strong and La Roi 1983a, b; Strong, Sidhu, and Navratil 1995; Tanner et al. 1996; Tidsbury et al. 1992; Tucker and Jarvis 1967; Volney and Cerezke 1992; Waldron 1964; Waldron and Kolabinski 1994; Wong et al. 1977; Yang 1989, 1991b; Yang and Bella 1994; Young 1979.

WILDLIFE RESOURCES

Amphibians

MacCallum and Ebel 1984; Roberts and Lewin 1979; Schieck and Roy 1995; Smith and Crook 1996.

Birds

C.D. Schultz and Company Ltd. 1973; Cotterill 1996; Cumming et al. 1995; D.A. Westworth and Associates Ltd. 1981; Doerr et al. 1974; Ealey 1979; Erskine 1977; Filion et al. 1983; Francis and Lumbis 1979; Gullion 1986; Hardy Associates (1978) Ltd. 1979; Hennan and Munson 1979; IEC Beak Consultants Ltd. 1984, 1985; Ives 1981; Kelsall et al. 1977; Leskiw et al. 1984; MacCallum and Ebel 1984; Machtan 1996; Navratil and Chapman 1991; Nietfeld et al. 1985; Parry, Spence, and Volney 1997; Rintoul and Myers 1983; Ross and La Roi 1984; Rusch and Keith 1971; Schieck and Nietfeld 1995; Schieck and Roy 1995; Semenchuk 1992; Smith and Crook 1996; Telfer 1974; Thompson et al. 1978; Weatherill and Keith 1969; Wein and MacLean 1983; Weldwood of Canada Limited 1990; Westworth et al. 1984; Wolliis 1991.

Furbearers

Alberta Energy and Natural Resources 1984b; Alberta Environmental Centre 1981; Boyd 1978; C.D. Schultz and Company Ltd. 1973; Ealey 1987; Fuller and Keith 1980a; Gilbert and Nancekirell 1982; Green 1980a; Hardy Associates (1978) Ltd. 1979; IEC Beak Consultants Ltd. 1984, 1985; Jaques

and Van Eck 1980; Kelsall et al. 1977; Leskiw et al. 1984; MacCallum and Ebel 1984; More 1978; Navratil, Bella, and Peterson 1990; Nielson 1975; Nietfeld et al. 1985; Novakowski 1967; O'Leary 1986; Pearson 1976; Pease et al. 1979; Penner et al. 1980; Rowan and Keith 1956; Roy et al. 1995; Rusch and Reeder 1978; Schieck and Roy 1995; Searing 1979; Skinner 1984; Stelfox (J.G.) 1984; Telfer 1974; Thompson et al. 1980; Tietje and Ruff 1980; Van Camp and Telfer 1975b; Weatherill and Keith 1969; Wooley 1972.

Invertebrates

Digweed 1995; Fleming and Volney 1995; Hammond 1996; Ives 1981; Langor et al. 1992, 1994; Parry 1994, 1995; Parry, Spence, and Volney 1997; Smith and Crook 1996; Spence and Langor 1994; Spence et al. 1996.

Small Mammals

Alberta Energy and Natural Resources 1984b; C.D. Schultz and Company Ltd. 1973; Cotterill 1996; Crampton 1995; Crampton and Barclay 1995; Ealey 1987; Filion et al. 1983; Green 1980a, b; Hardy Associates (1978) Ltd. 1979; Ives 1981; Johnson 1987; Jones 1978; Kelsall et al. 1977; Kemp and Keith 1970; MacCallum and Ebel 1984; McDonald 1995; More 1978; O'Leary 1986; Penner 1990; Roy et al. 1995; Schieck and Roy 1995; Smith and Crook 1996; Stelfox (J.G.) 1984; Telfer 1974; Van Camp and Telfer 1975b; Weatherill and Keith 1969; Wein and MacLean 1983; Weaver 1996; Volney 1996.

Ungulates

Alberta Energy and Natural Resources 1984b; Alberta Environmental Protection 1996b; Beak Associates Consulting Ltd. 1987; Bichlmaier 1985; Cairns 1976; Cairns and Telfer 1980; C.D. Schultz and Company Ltd. 1973; Ealey 1987; Eberhart 1986; Filion et al. 1983; Fuller and Keith 1980a, b, 1981; Hardy Associates (1978) Ltd. 1979; Hauge and Keith 1981; Hudson 1975; Hunt 1976, 1978; IEC Beak Consultants Ltd. 1984, 1985; Jaques and Van Eck 1980; Knapik and Westworth 1984; Krämer 1972; Leskiw et al. 1984; MacCallum and Ebel 1984; Mytton and Keith 1981; Navratil, Bella, and Peterson 1990; Navratil and Chapman 1991; Nietfeld 1983; Nietfeld and Hudson 1985; Nietfeld et al. 1985; Nowlin 1978; O'Leary 1986; Renecker 1986; Renecker and Hudson 1985, 1986; Rolley and Keith 1979, 1980; Roy et al. 1995; Schewe and Stewart 1986; Schieck and Roy 1995; Stelfox (J.B.) 1989; Stelfox (J.B.) et al. 1991, 1995; Stelfox (J.G.)

1981, 1984, 1988; Stelfox (J.G.) et al. 1973, 1976; Stewart et al. 1977; Telfer 1974, 1978, 1984; Telfer and Cairns 1978; Telfer and Scotter 1969; Thompson et al. 1978, 1980; Thorpe 1978; Timmermann and McNicol 1988; Tonn 1978; Tonn et al. 1981; Trotter 1980; Usher 1978, 1981; Van Camp and Telfer 1975a; Weldwood of Canada Limited 1990; Westworth et al. 1984.

Wildlife Distribution and Diversity

Alberta Energy and Natural Resources 1984b; Boyd 1978; Cairns and Telfer 1980; Cotterill 1996; Crampton 1995; Crampton and Barclay 1995; Downing and Legris 1988; Ealey 1979, 1987; Erskine 1977; Francis and Lumbis 1979; Fuller and Keith 1980a, b, 1981; Gilbert and Nancekirell 1982; Green 1980a; Hardy Associates (1978) Ltd. 1979; Harris et al. 1983; Hauge and Keith 1981; Hennen and Munson 1979; Hunt 1976; IEC Beak Consultants Ltd. 1984; Jones 1978; Kelsall et al. 1977; Kemp and Keith 1970; Krämer 1972; MacCallum and Ebel 1984; Machtan 1996; MacIsaac 1986; McDonald 1995; Mytton and Keith 1981; Nielson 1975; Nietfeld et al. 1985; Pearson 1976; Penner 1990; Penner and Associates Ltd. 1991; Penner et al. 1980; Peterson and Peterson 1992; Renecker 1986; Roberts and Lewin 1979; Rolley and Keith 1979, 1980; Rowan and Keith 1956; Rowe and Scotter 1973; Roy et al. 1995; Rusch and Keith 1971; Rusch and Reeder 1978; Saskatchewan Power Corporation 1977; Schieck and Nietfeld 1995; Schieck and Roy 1995; Searing 1979; Semenchuk 1992; Stelfox (H.) 1981, Stelfox (J.B.) 1989; Stelfox (J.B.) et al. 1991, 1995; Stelfox (J.G.) 1981, 1984, 1988; Stelfox (J.G.) et al. 1973, 1976; Telfer 1978, 1984; Tietje and Ruff 1980; Weaver 1996; Wollis 1991; Wooley 1972.

Wildlife-habitat Assessment

Alberta Environmental Protection 1996b; Alberta Forestry, Lands, and Wildlife 1991b; Archibald 1981, 1982; Beak Associates Consulting Ltd. 1987; Bichlmaier 1985; Bishoff 1981b; Bovar Environmental 1996; Boyd 1978; Cairns 1976; Cairns and Telfer 1980; Crampton 1995; Cumming et al. 1995; D.A. Westworth and Associates Ltd. 1981; Doerr et al. 1974; Ealey 1979, 1987; Eberhart 1986; Eberhart and Woodard 1987; Erskine 1977; Francis and Lumbis 1979; Gilbert and Nancekirell 1982; Green 1980a; Gullion 1986; Hennen and Munson 1979; Hudson 1975; Hunt 1976, 1978; IEC Beak Consultants Ltd. 1985; Jaques and Van Eck 1980; Kansas and Brown 1992; Kemp and Keith 1970; Kiil 1970; Knapik et al. 1985; Knapik and Westworth 1984; Krämer 1972; Leskiw et al. 1984; MacCallum and Ebel 1984; More 1978; Mytton and Keith 1981; Nietfeld 1983; Nietfeld and Hudson 1985; Nietfeld et al. 1985; Novakowski 1967; Nowlin 1978; O'Leary and Downing 1986a; Pearson 1976; Pease et al. 1979; Peters 1981; Renecker 1986; Renecker and Hudson 1985, 1986; Rintoul and Myers 1983; Rolley and Keith 1979, 1980; Russell 1986; Russell et al. 1984; Schewe and Stewart 1986; Searing 1979; Shoup et al. 1968; Skinner 1984; Stelfox (J.B.) et al. 1991; Stelfox (J.G.) 1981, 1984, 1988; Stelfox (J.G.) et al. 1973, 1976; Stewart et al. 1977; Strong 1982; Syncrude Canada Ltd. 1973; Telfer 1974, 1978, 1984; Telfer and Cairns 1978; Telfer and Scotter 1969; Thompson et al. 1978; Tietje and Ruff 1980; Timmermann and McNicol 1988; Trotter 1980; Usher 1978, 1981; Van Camp and Telfer 1975a, b; Weatherill and Keith 1969; Weldwood of Canada Limited 1990; Westworth et al. 1984.